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(54) **SINGLE ARM MOGUL MOUNT FOR SPORTS LIGHTING FIXTURES**

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(21) Appl. No.: **11/333,996**

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(60) Provisional application No. 60/644,687, filed on Jan. 18, 2005. Provisional application No. 60/644,639, filed on Jan. 18, 2005. Provisional application No. 60/644,536, filed on Jan. 18, 2005. Provisional application No. 60/644,747, filed on Jan. 18, 2005. Provisional application No. 60/644,534, filed on Jan. 18, 2005. Provisional application No. 60/644,720, filed on Jan. 18, 2005. Provisional application No. 60/644,688, filed on Jan. 18, 2005. Provisional application No. 60/644,636, filed on Jan. 18, 2005. Provisional application No. 60/644,517, filed on Jan. 18, 2005. Provisional application No. 60/644,609, filed on Jan. 18, 2005. Provisional application No. 60/644,516, filed on Jan. 18, 2005. Provisional application No. 60/644,546, filed on Jan. 18, 2005. Provisional application No. 60/644,547, filed on Jan. 18, 2005. Provisional application No. 60/644,638, filed on Jan. 18, 2005. Provisional application No. 60/644,537, filed on Jan. 18, 2005. Provisional application No. 60/644,637, filed on Jan. 18, 2005. Provisional application No. 60/644,719, filed on Jan. 18, 2005. Provisional application No. 60/644,784, filed on Jan. 18, 2005.

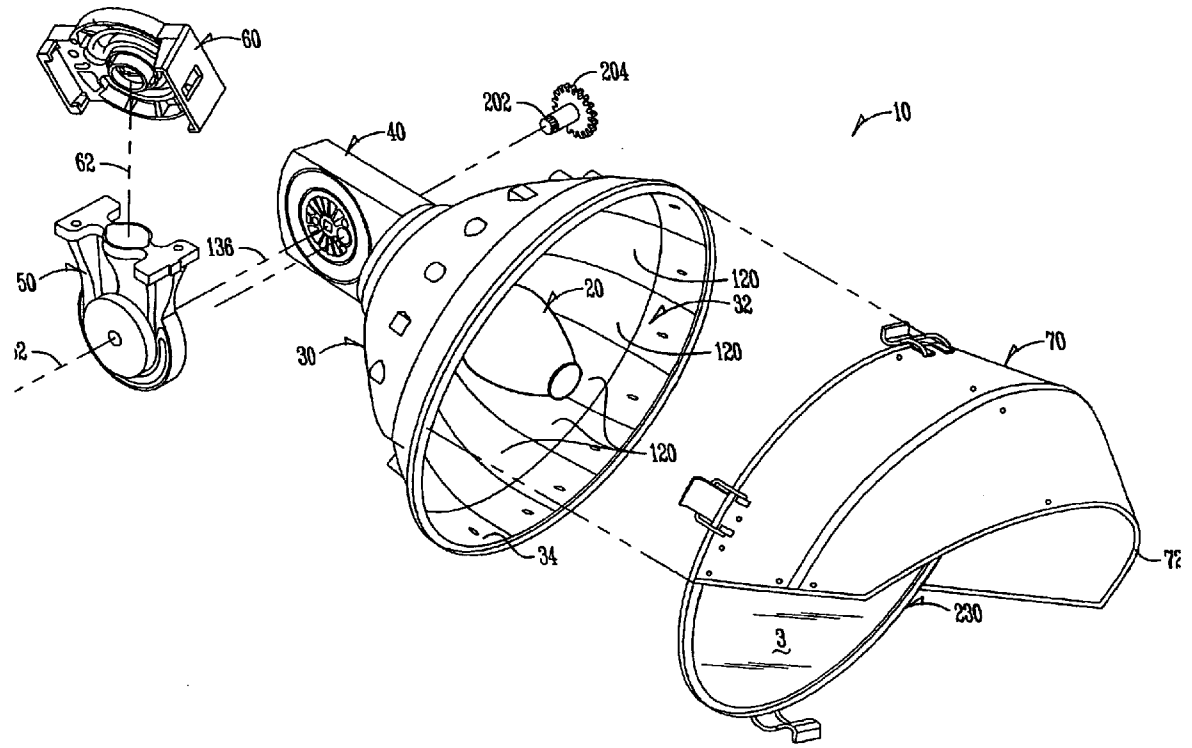
**Publication Classification**

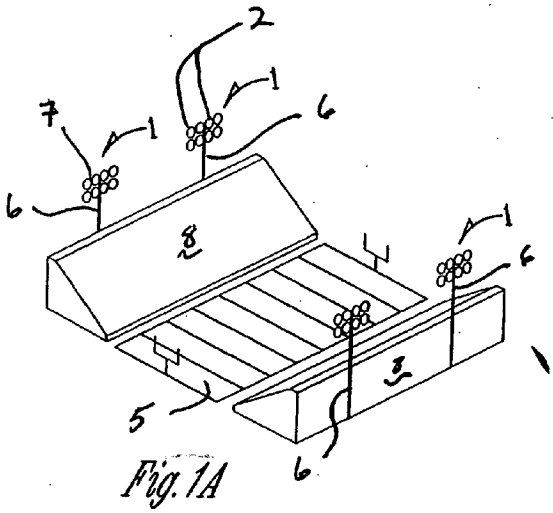
(51) **Int. Cl.**
*F21S 8/00* (2006.01)

(52) **U.S. Cl.** ..... **362/427**

(57) **ABSTRACT**

An apparatus and method for a high intensity lighting fixture. One aspect, a knuckle for mounting the light fixture by its bulb cone to a cross arm is attached along the side of the bulb cone. This has various potential advantages including decreased effective projected area, protection of watering to the bulb cone, and decreased moment.



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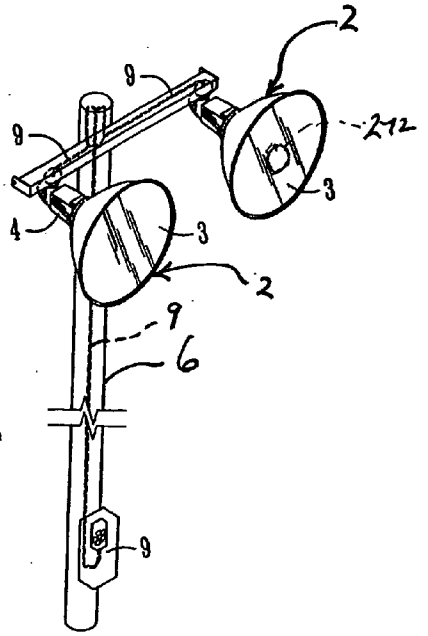



Fig. 1B

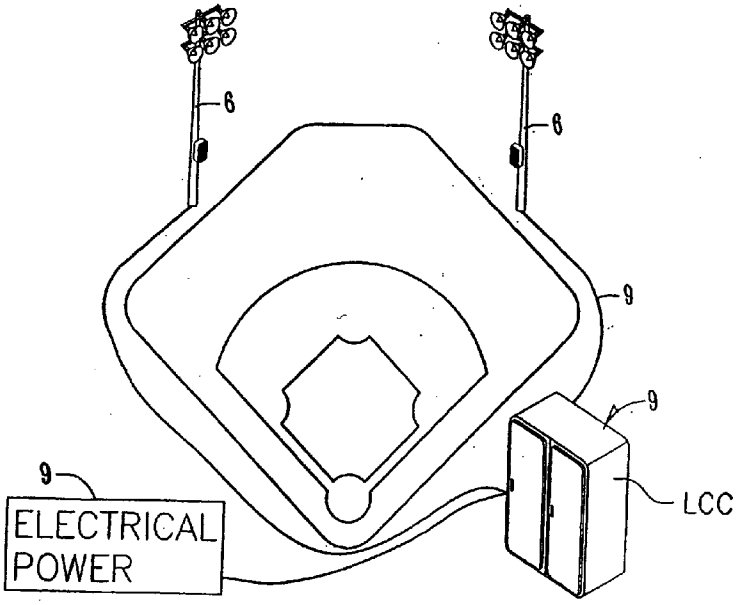



Fig. 1C

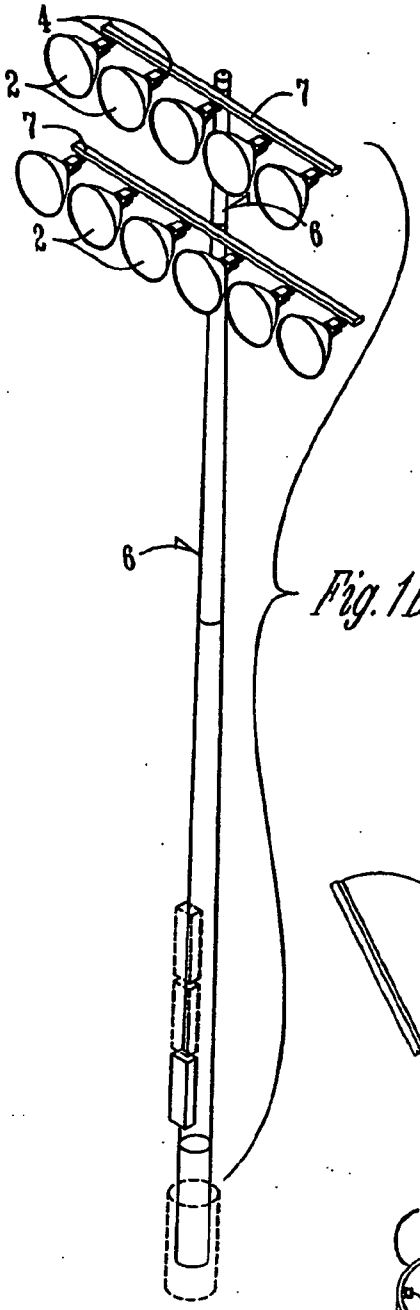



Fig. 1D

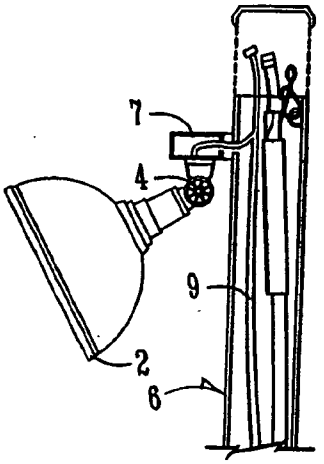
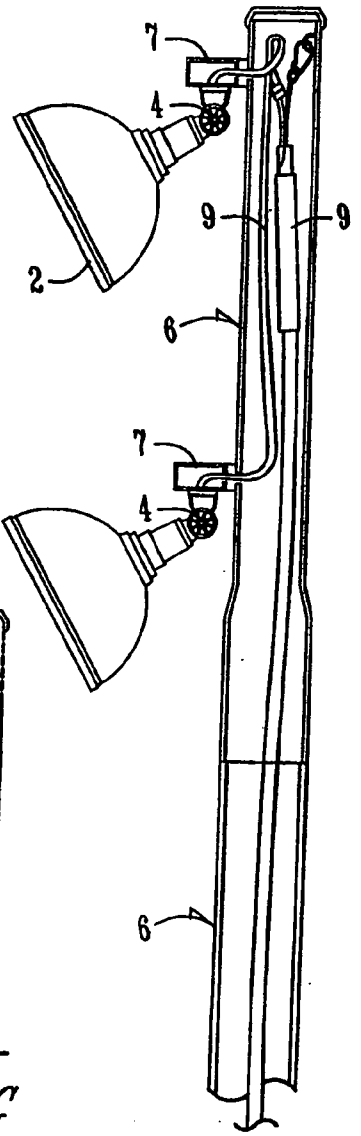



Fig. 1G

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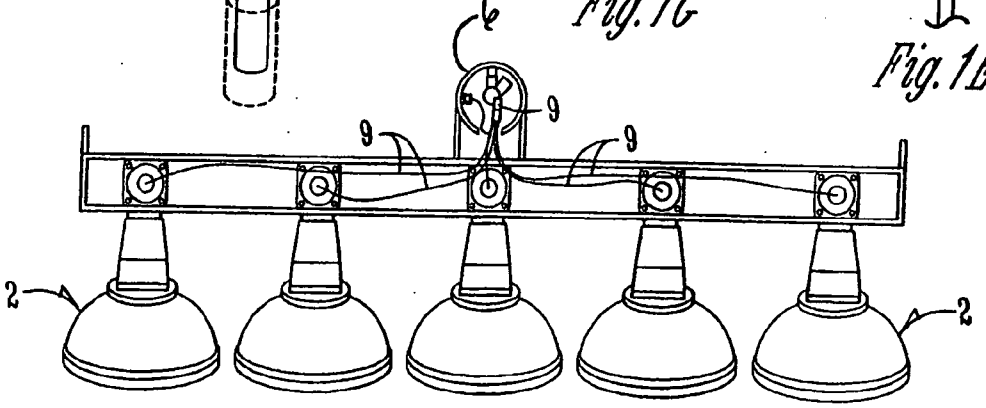



Fig. 1F

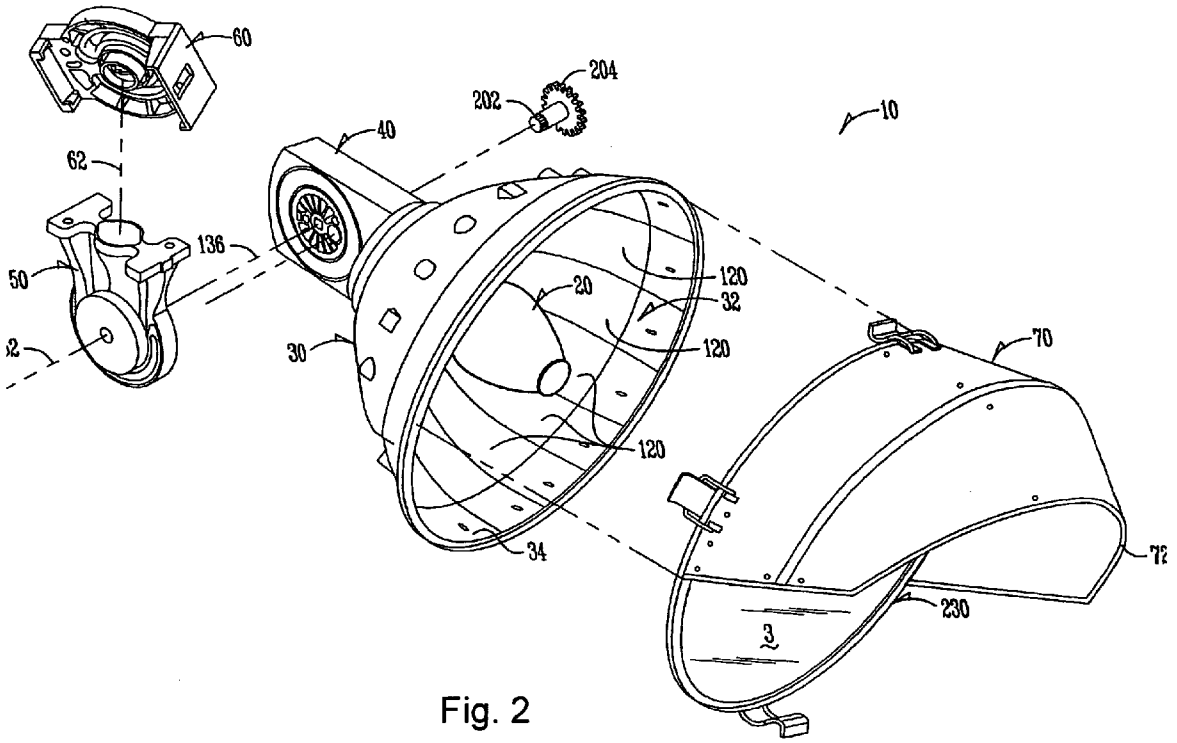



Fig. 2

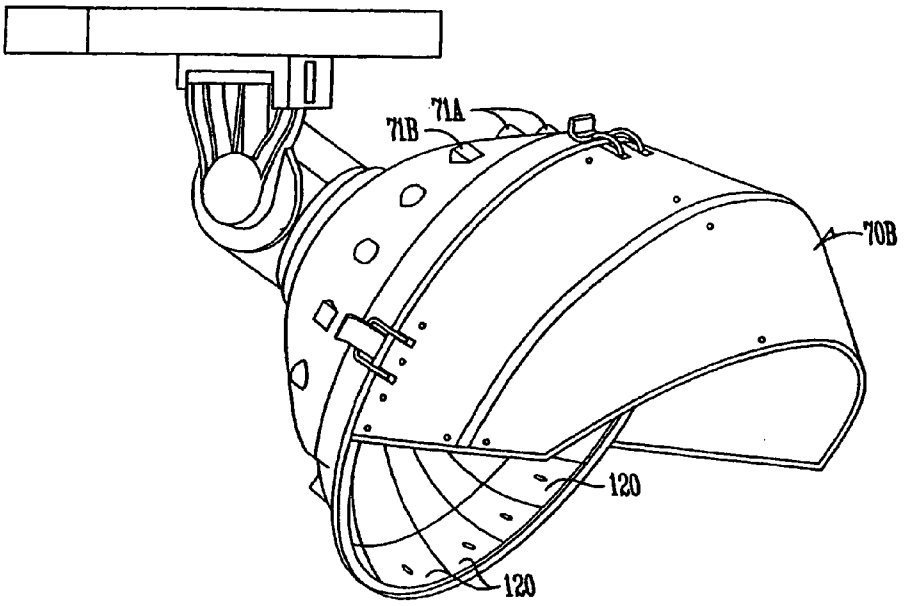
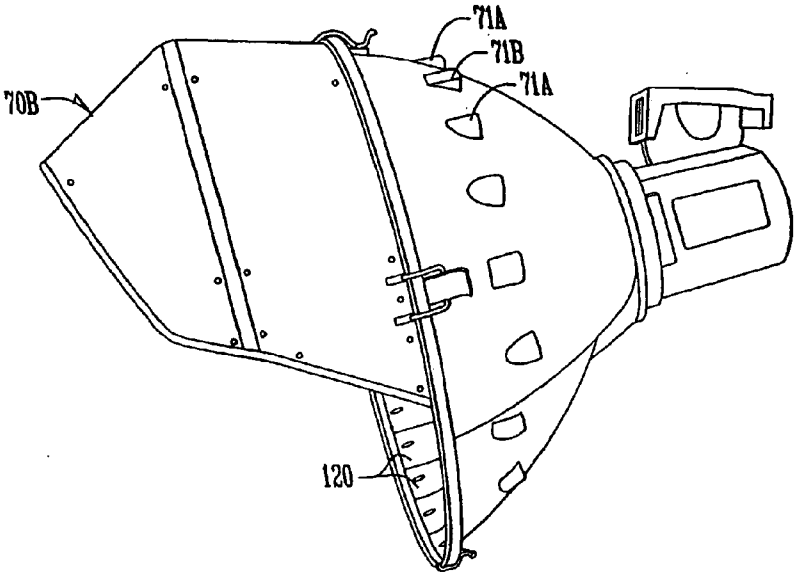



Fig. 3A

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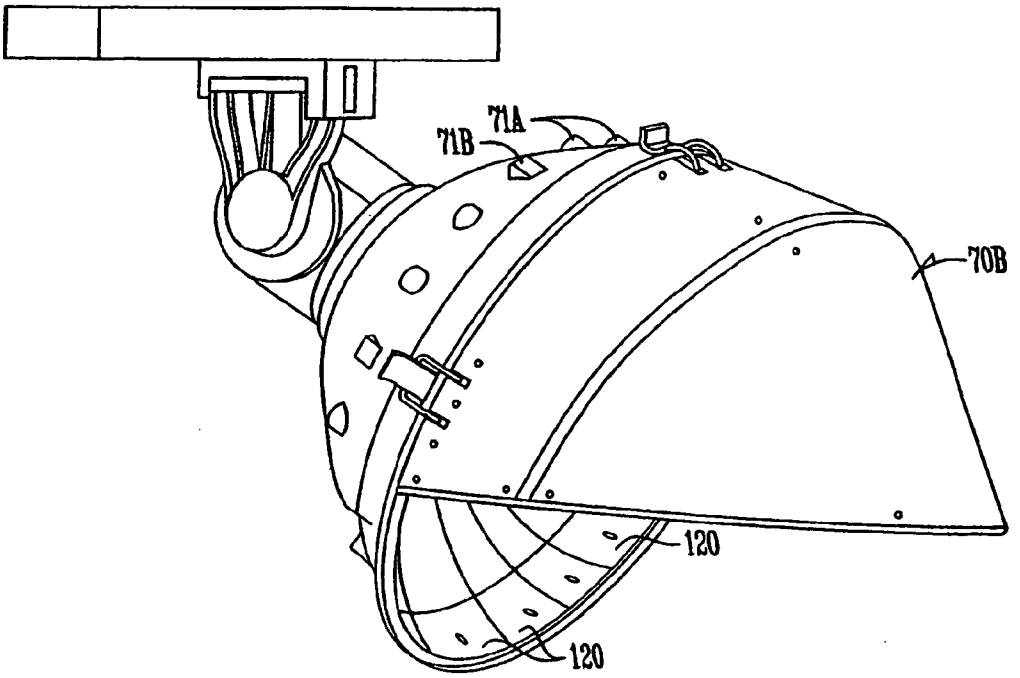


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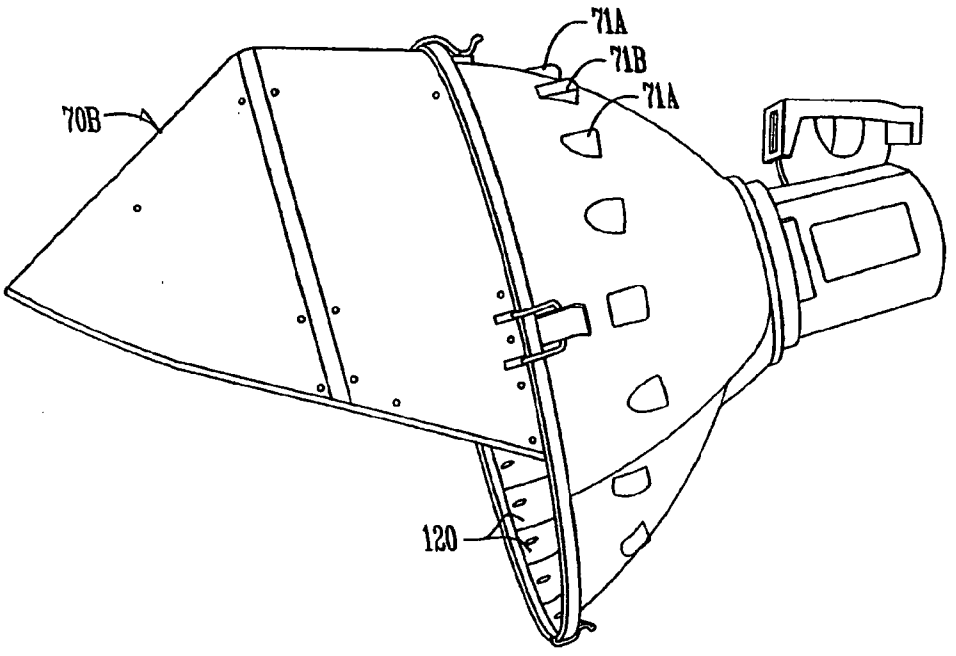


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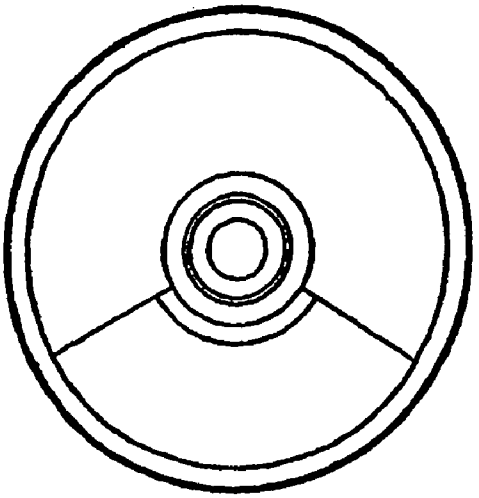

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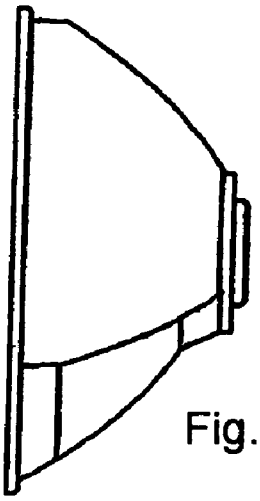

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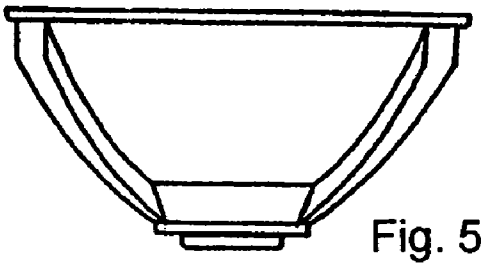

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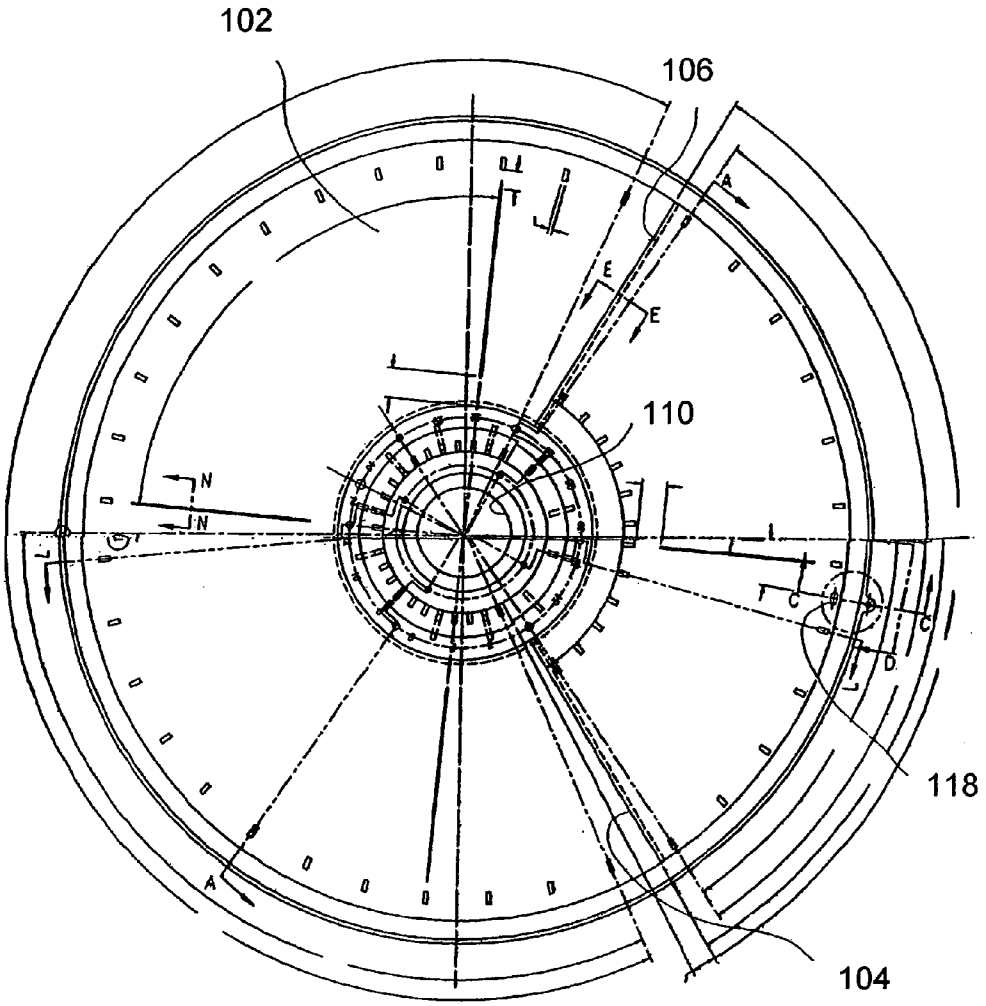


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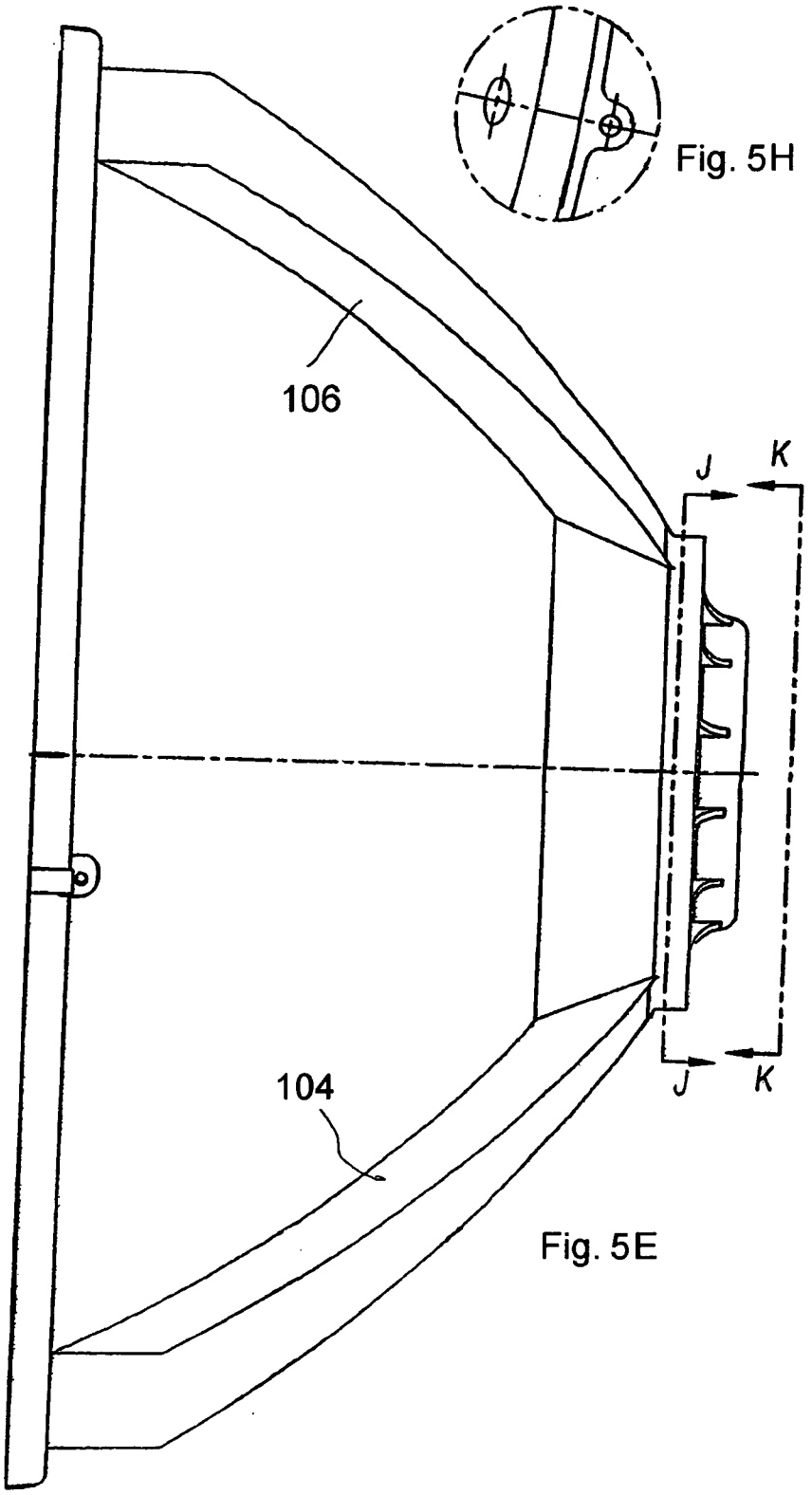
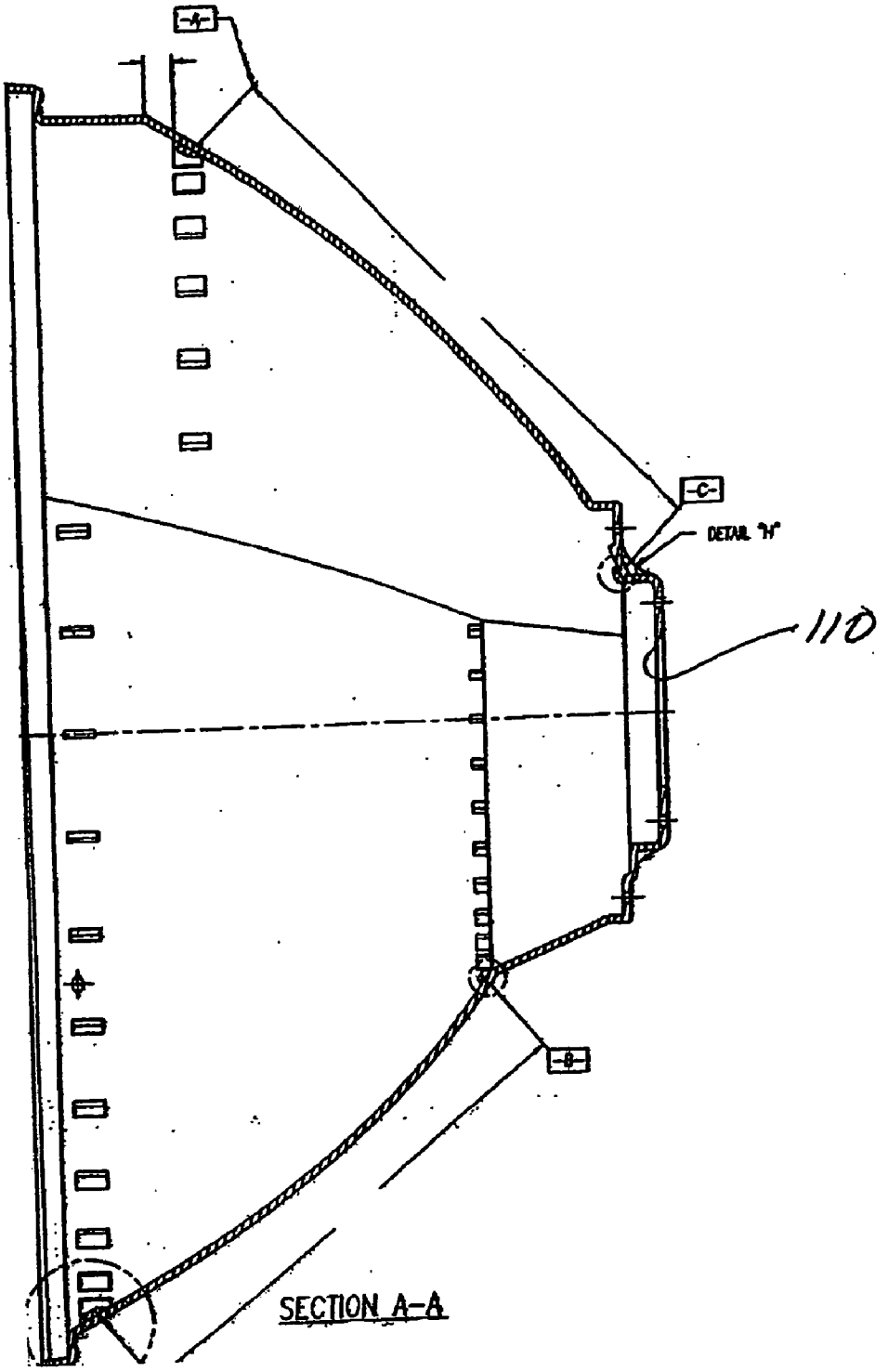



Fig. 5H

Fig. 5E

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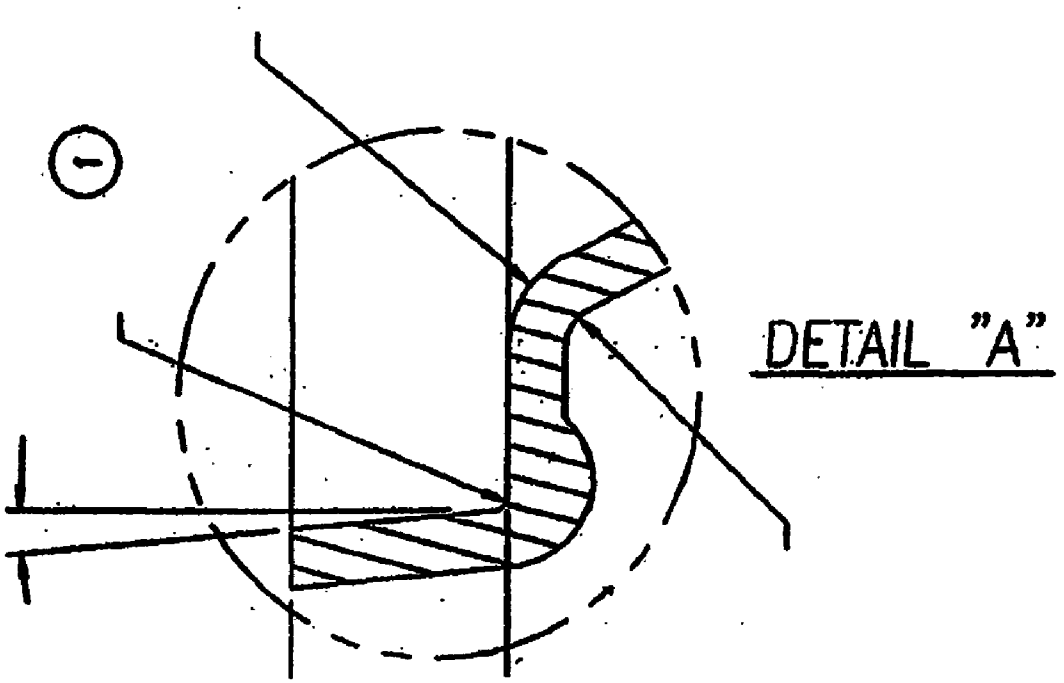


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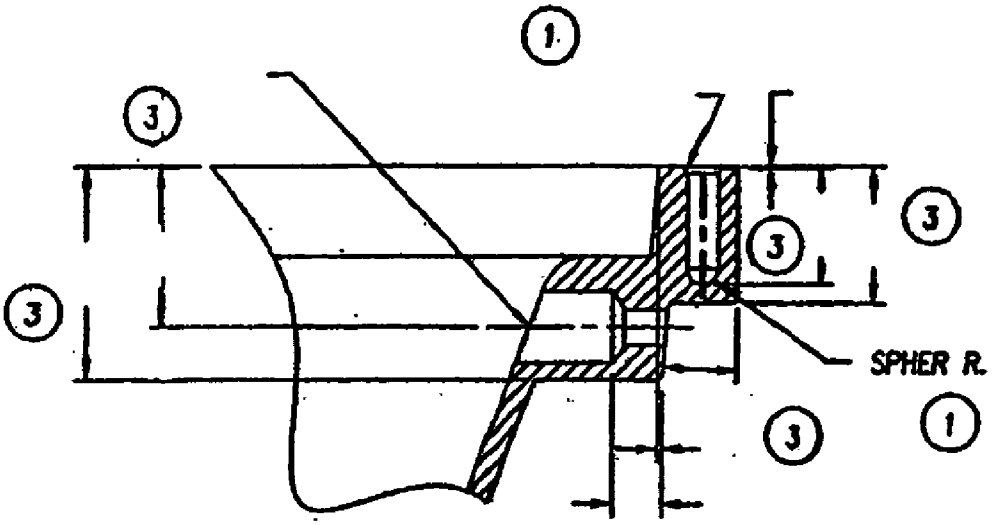
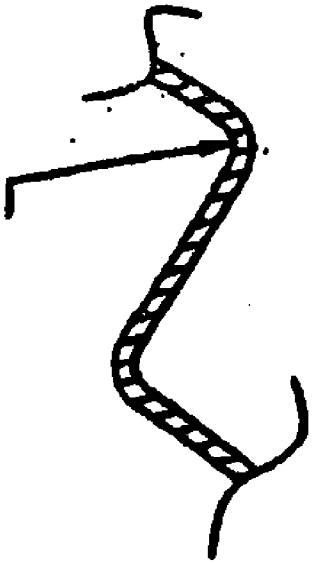



SECTION C-C

Fig. 5I

SECTION E-E



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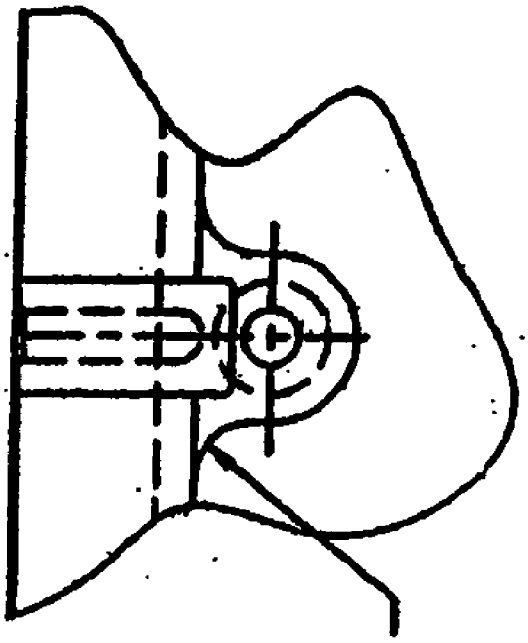
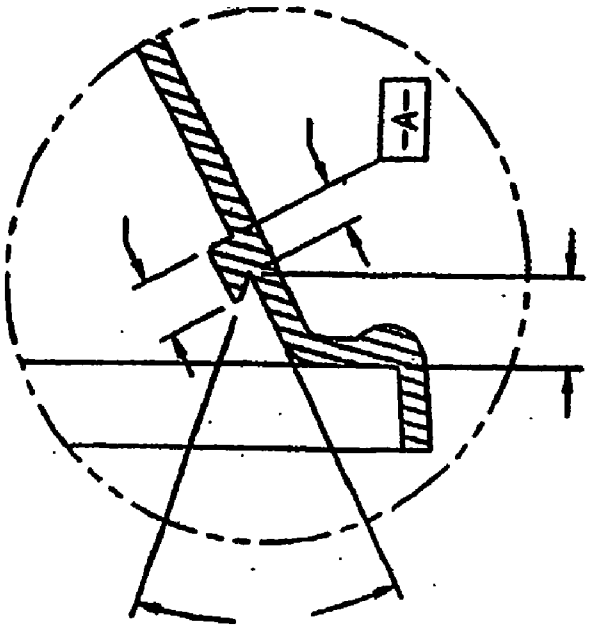


Fig. 5J

VIEW D-D



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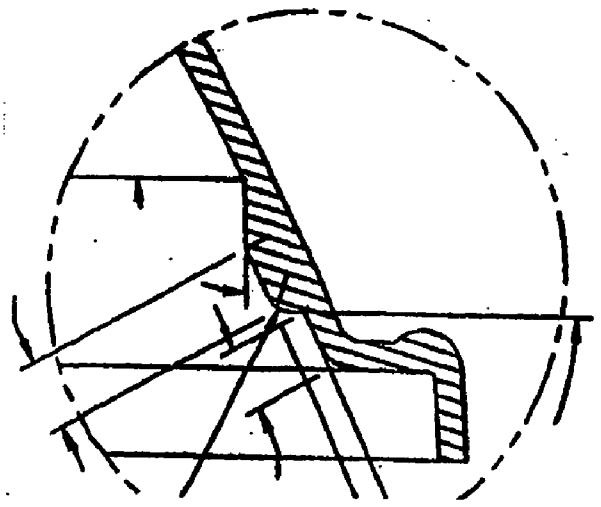

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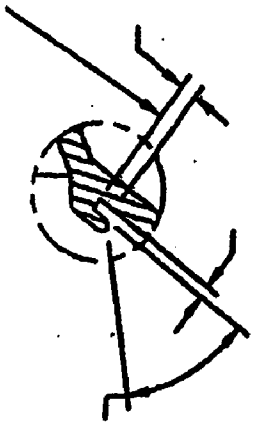

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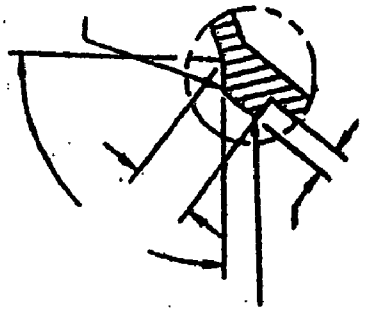

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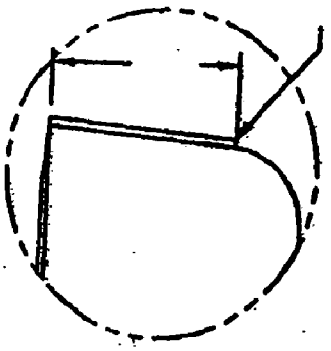
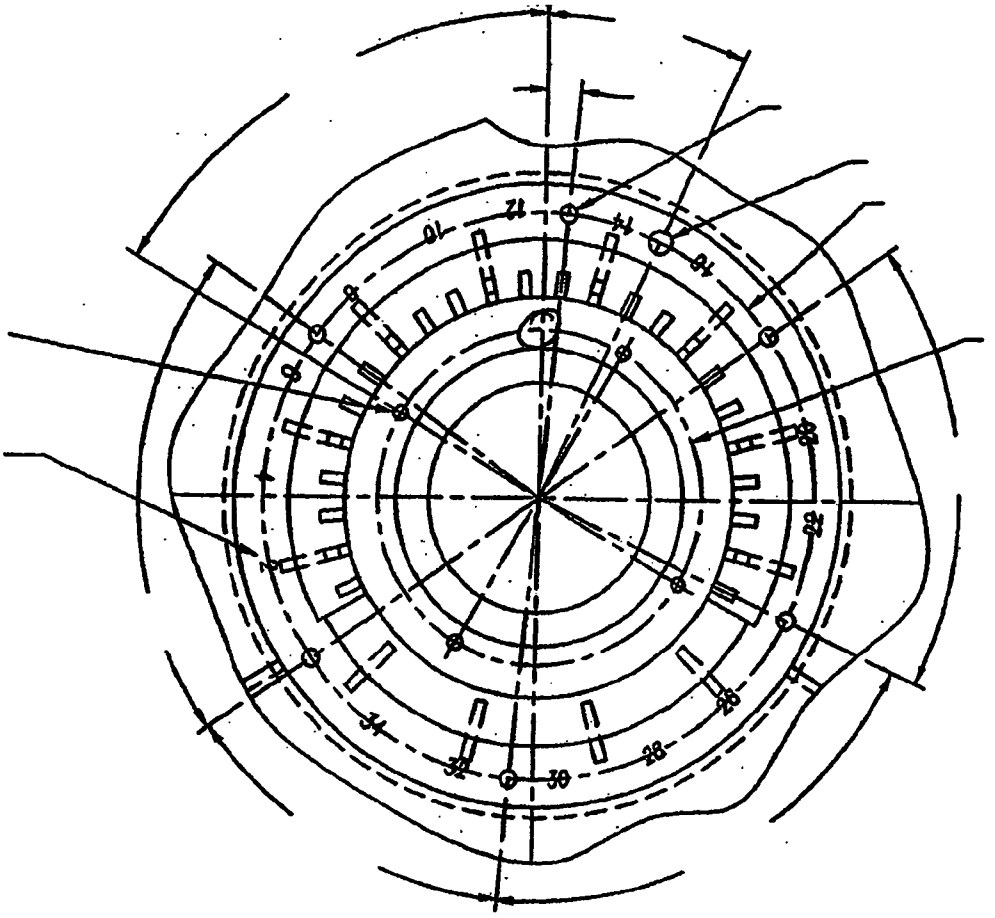


Fig 5Y



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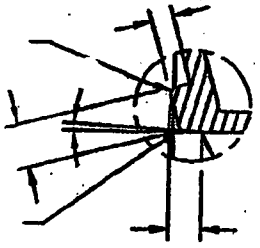

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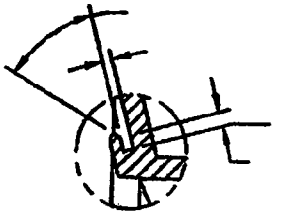

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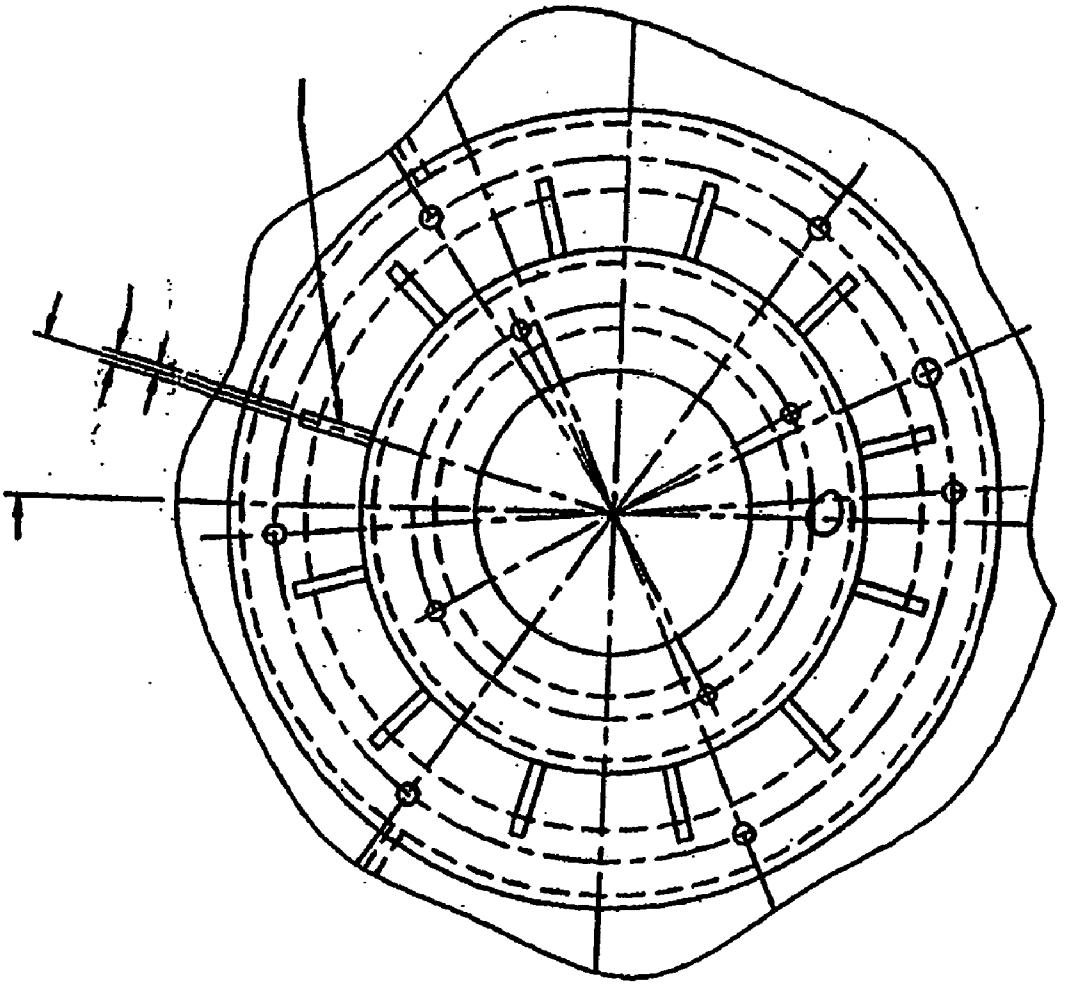

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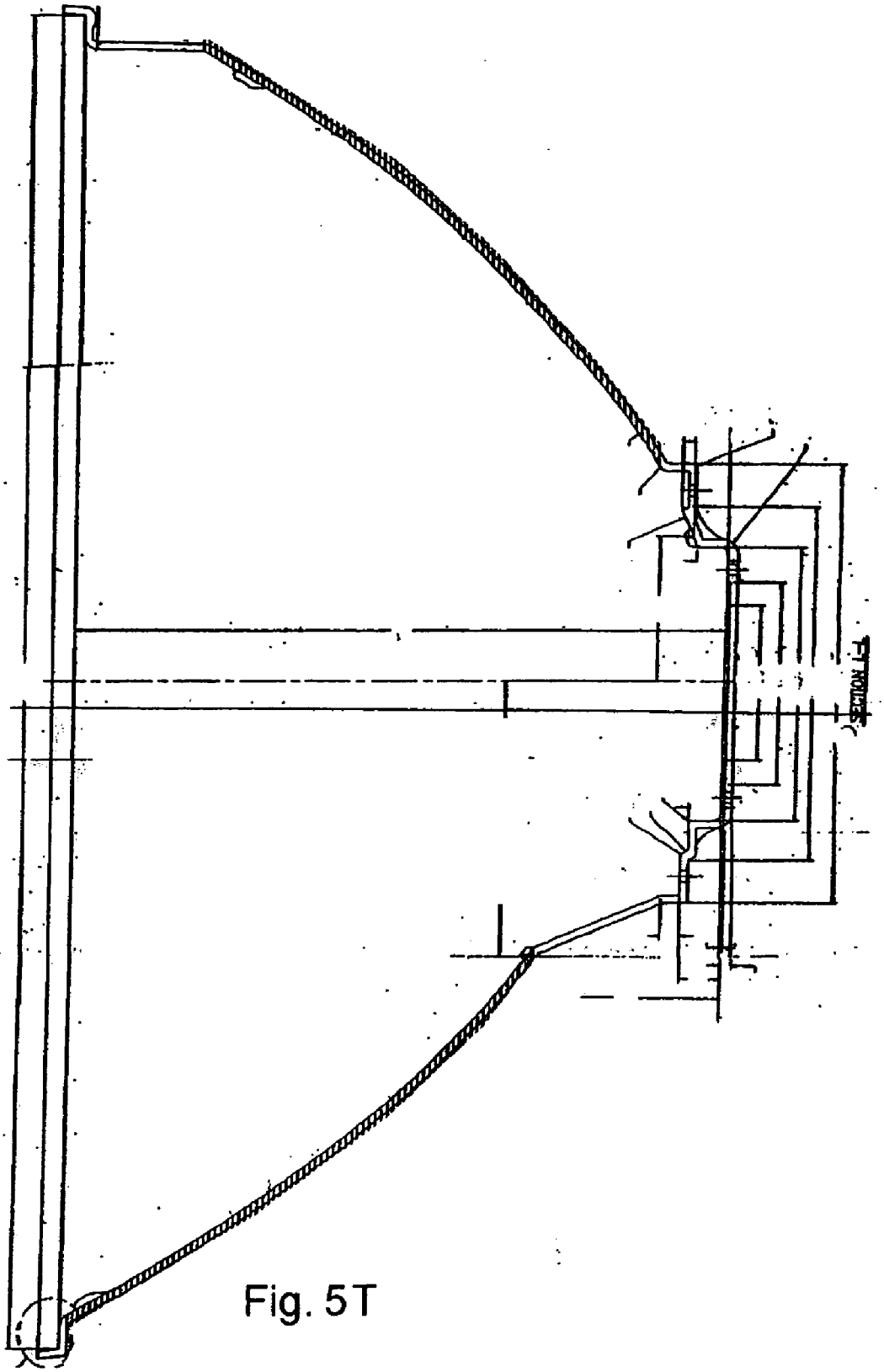

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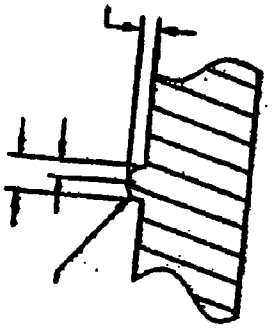

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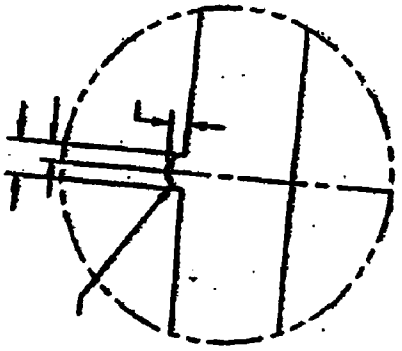

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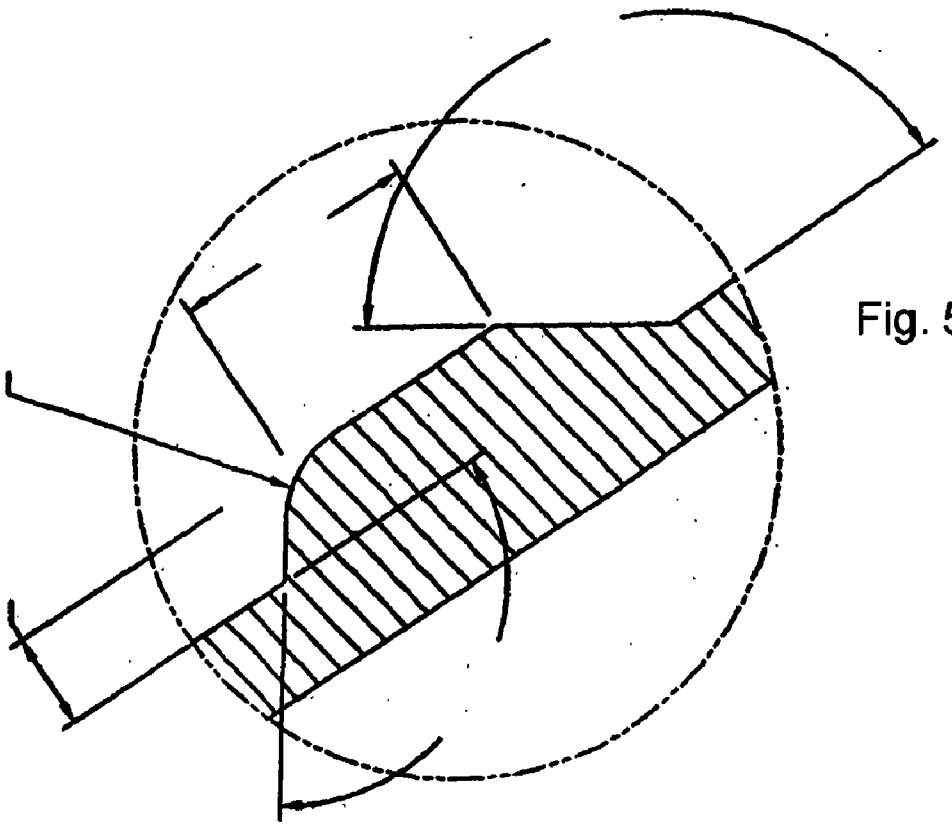

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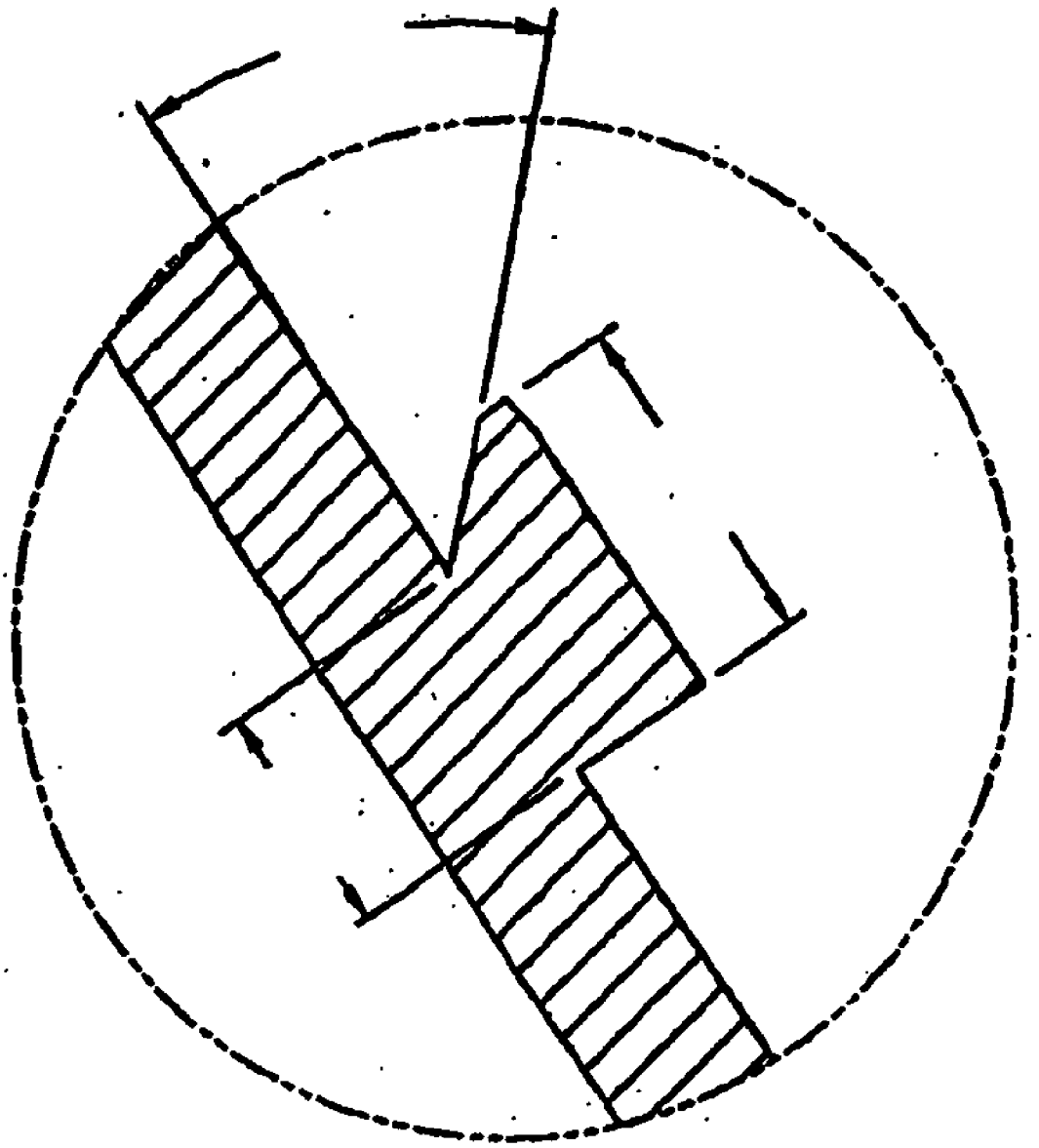

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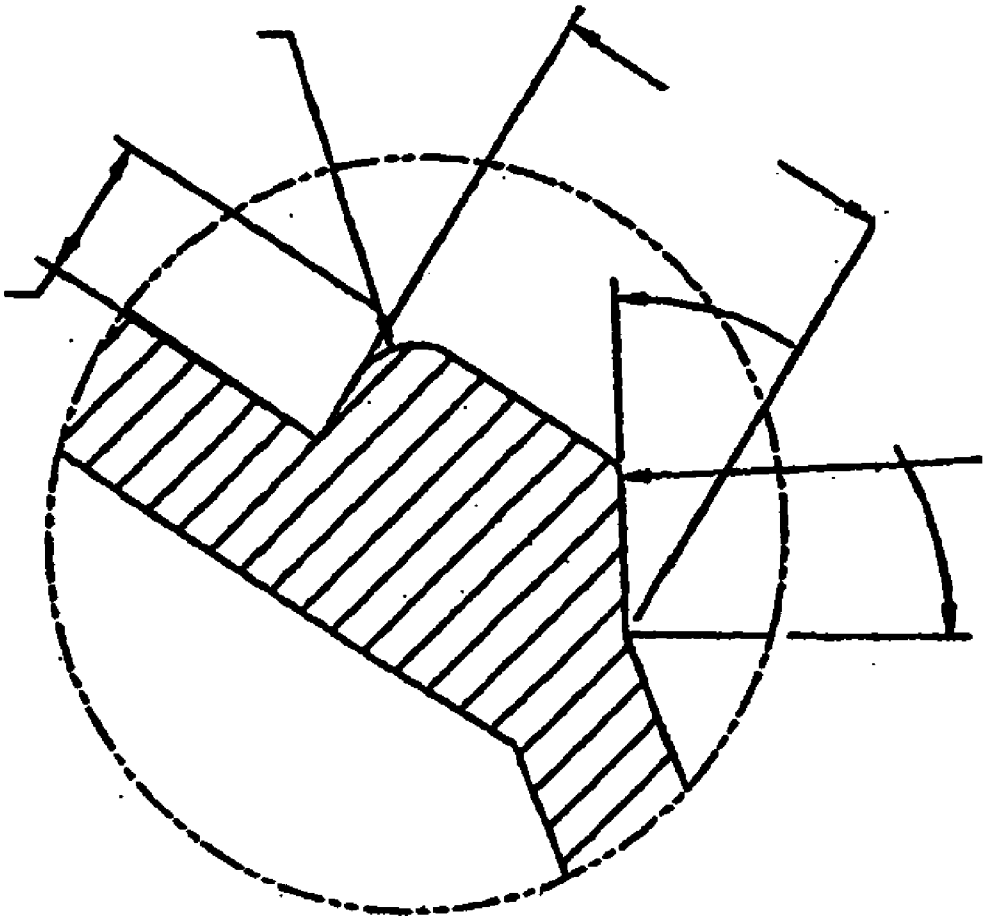

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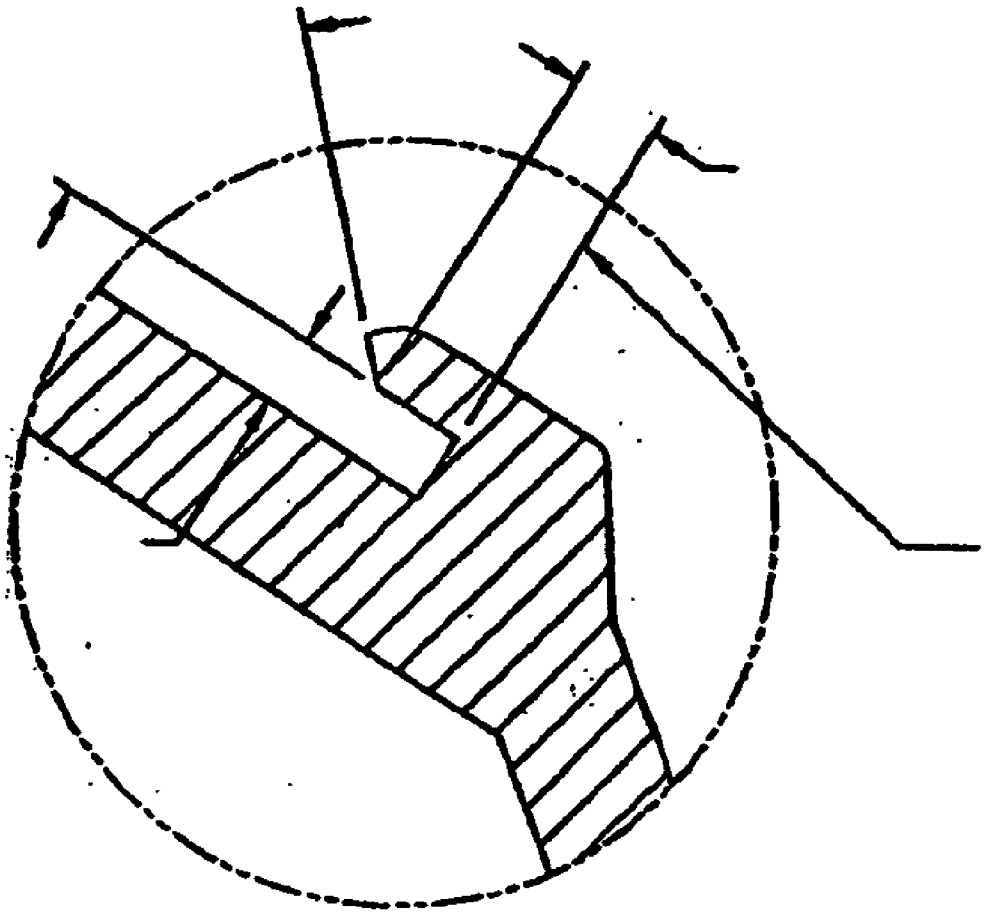

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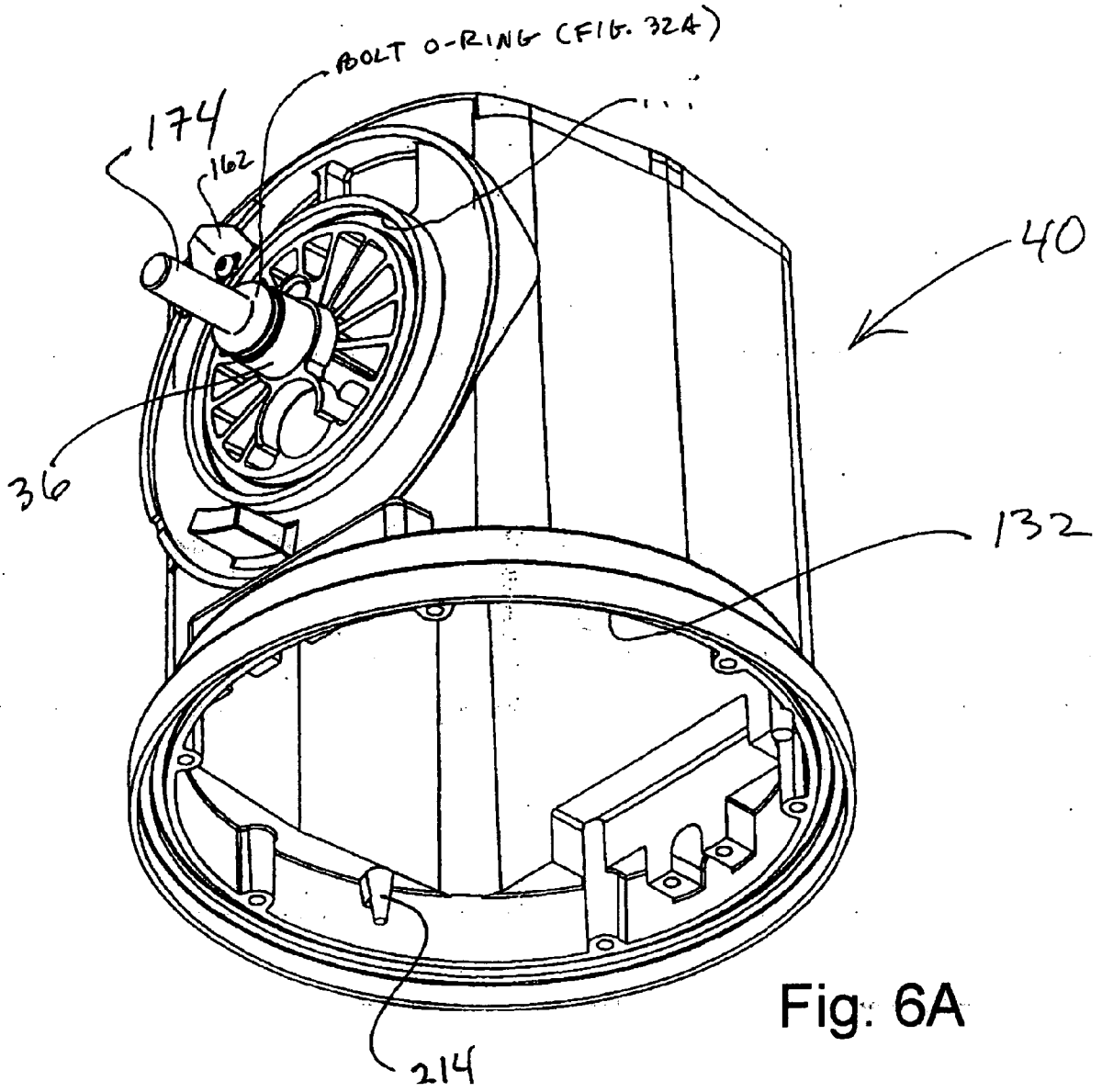


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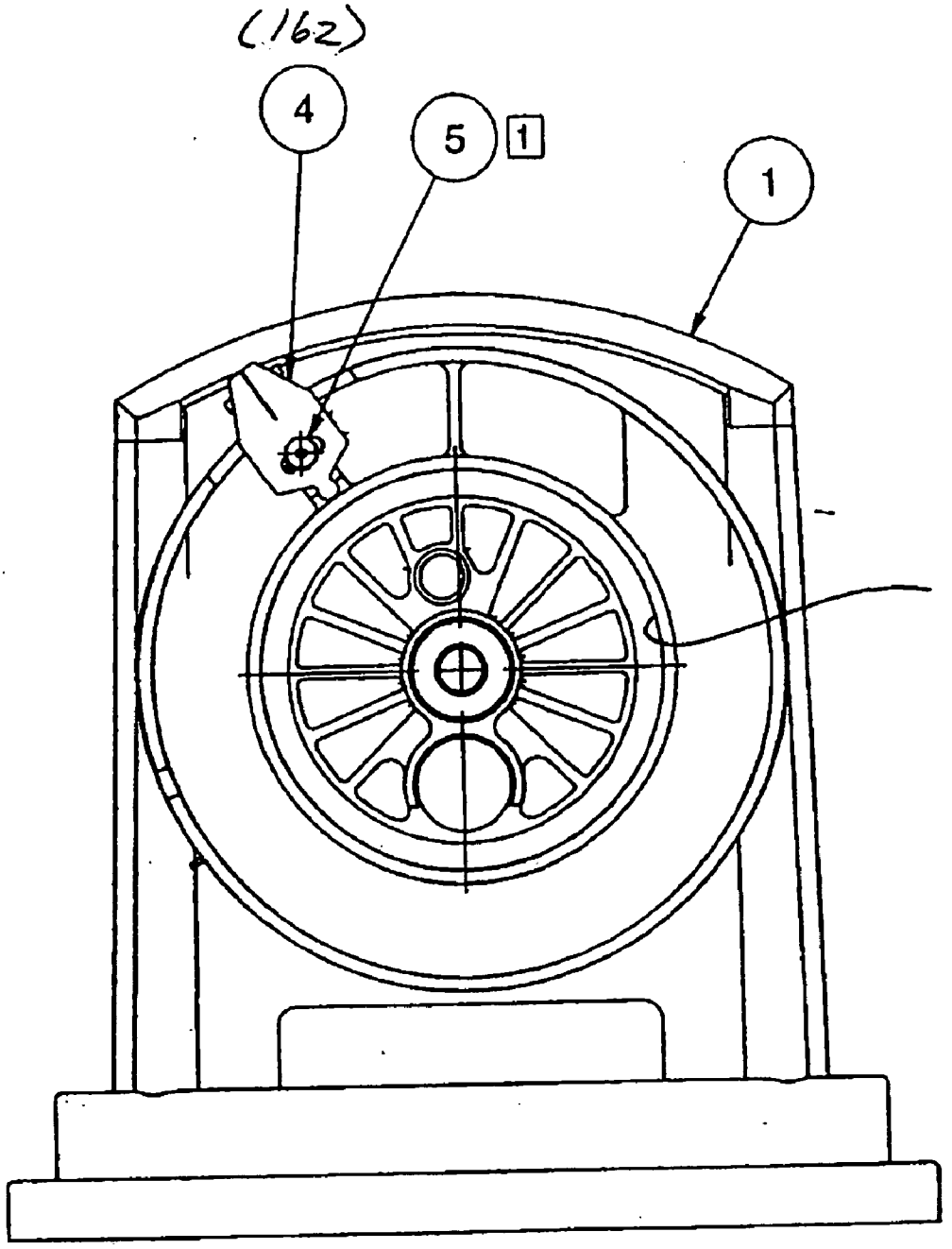


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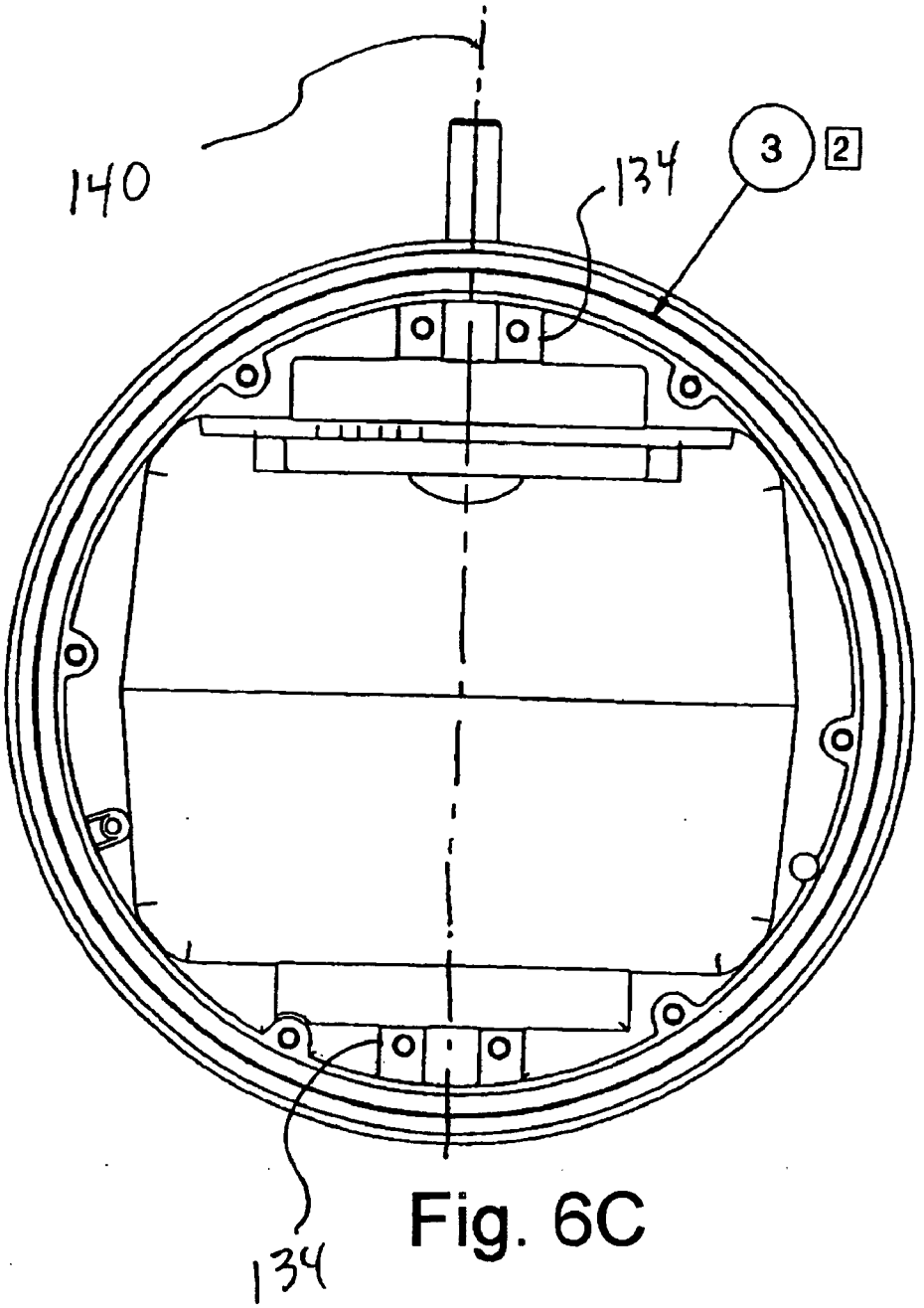


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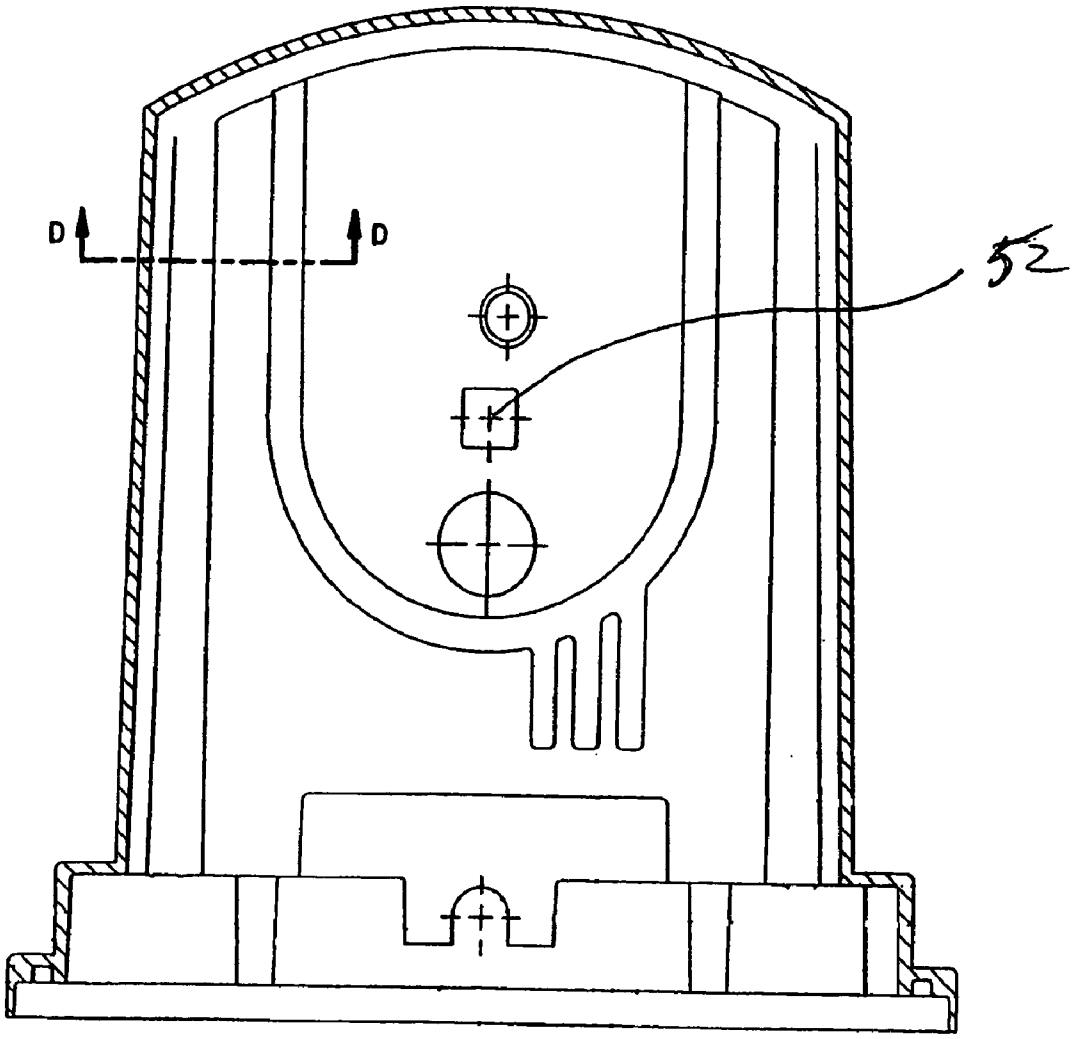


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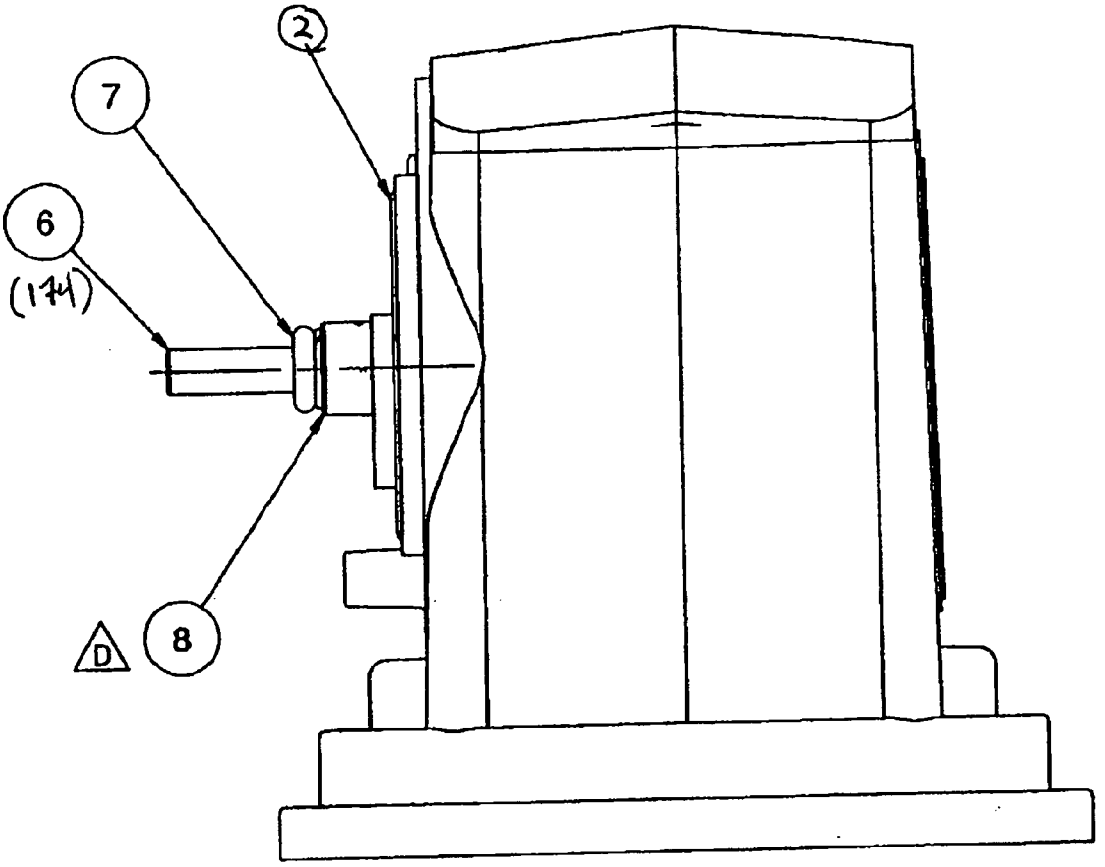


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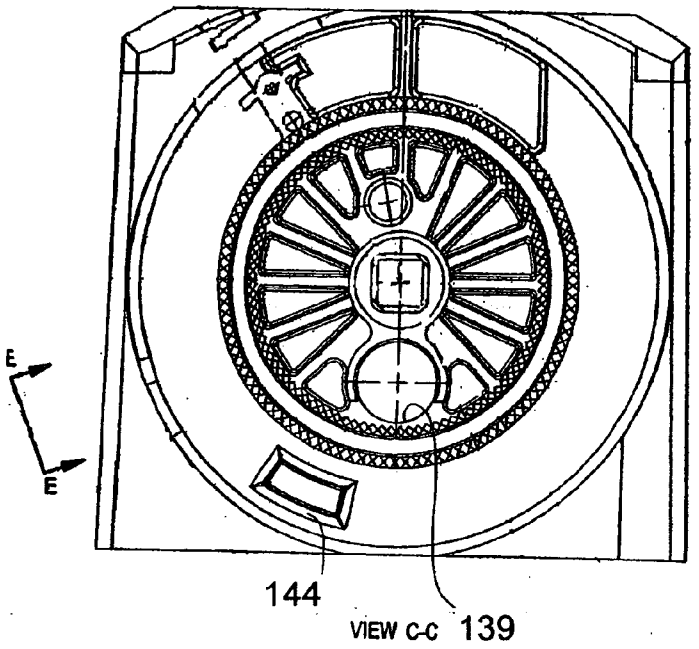


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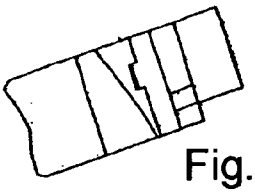


Fig. 6H (Section E-E)

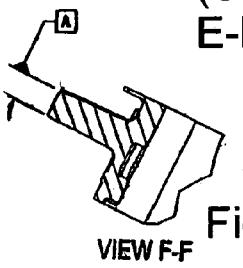
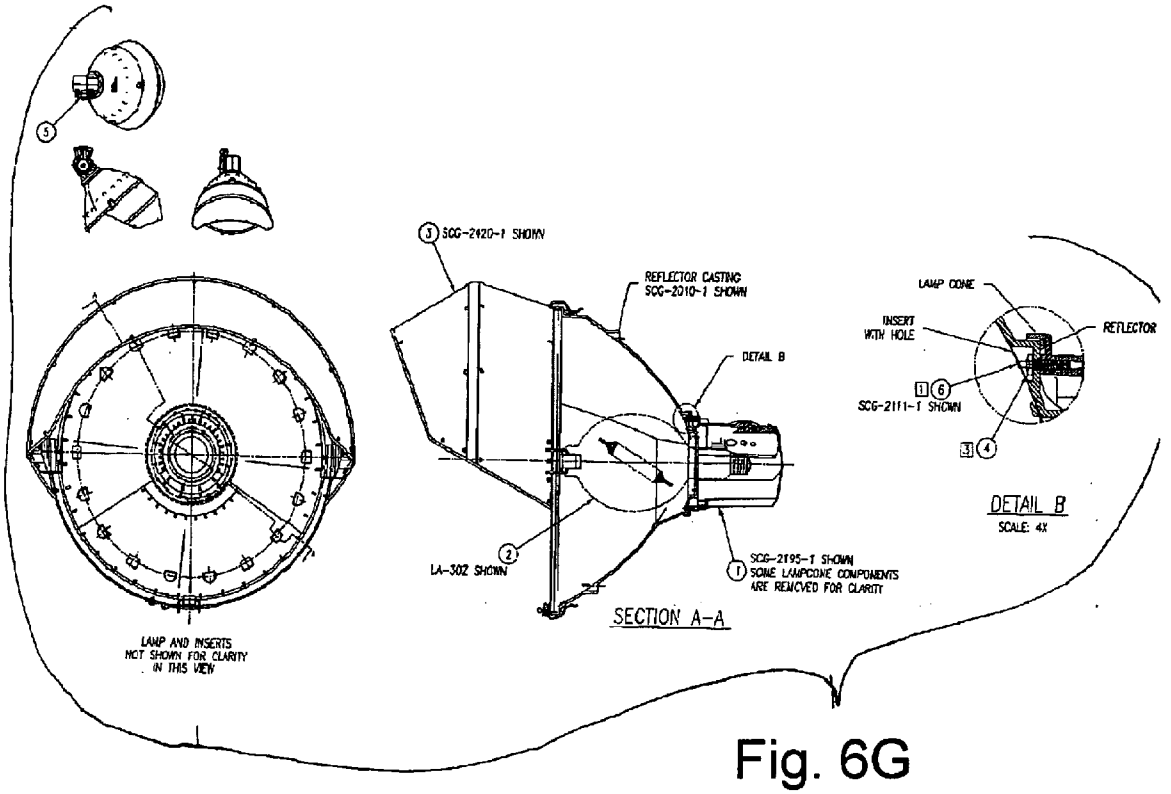



Fig. 6I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REFLECTOR CASTING SCG-2010-1 SHOWN
DETAIL B
LAMP CONE
INSERT WITH HOLE
REFLECTOR
1 6
SCG-2111-1 SHOWN
3 4
DETAIL B
SCALE: 4X
LAMP AND INSERTS NOT SHOWN FOR CLARITY IN THIS VIEW
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LA-302 SHOWN
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SECTION A-A

Fig. 6G

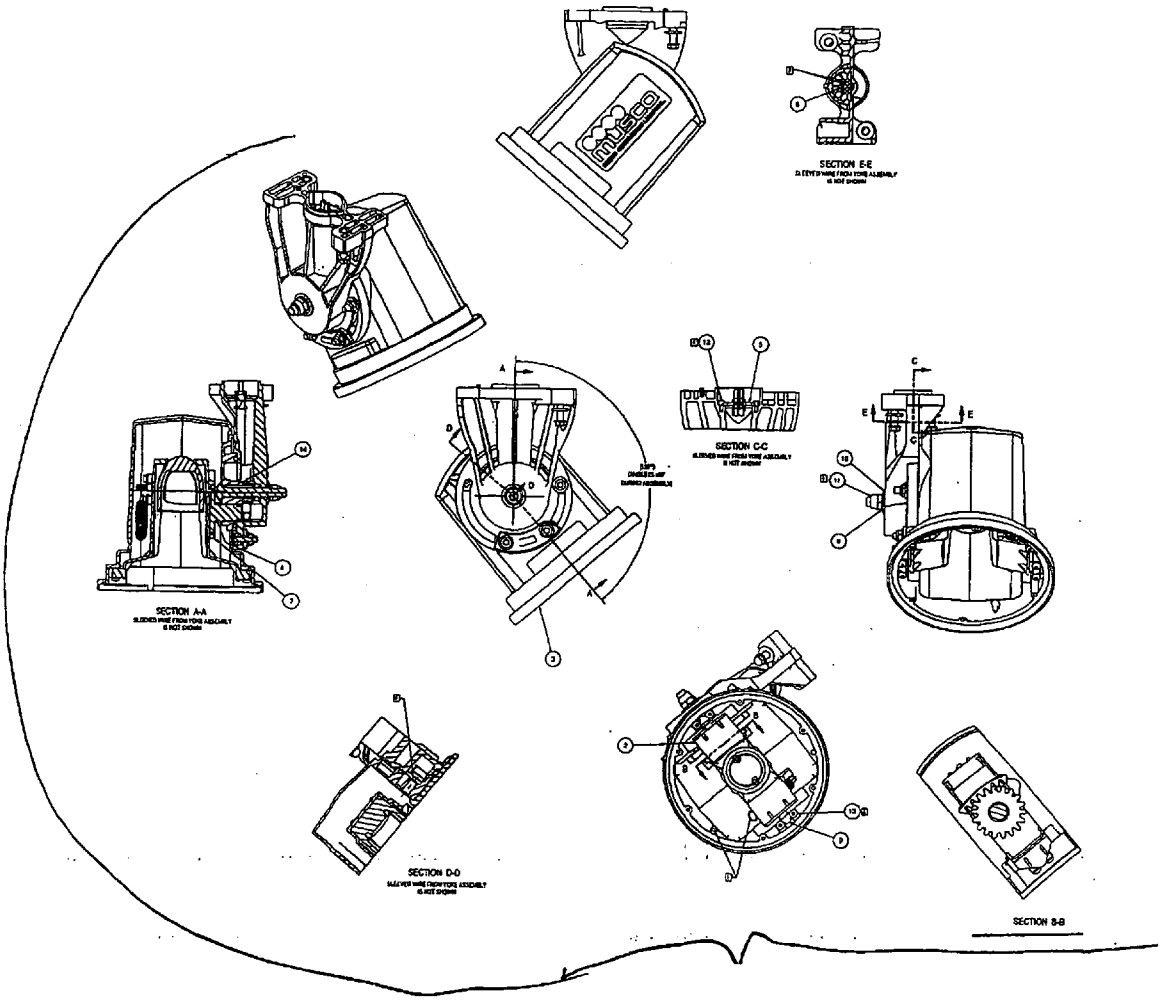



Fig. 6J

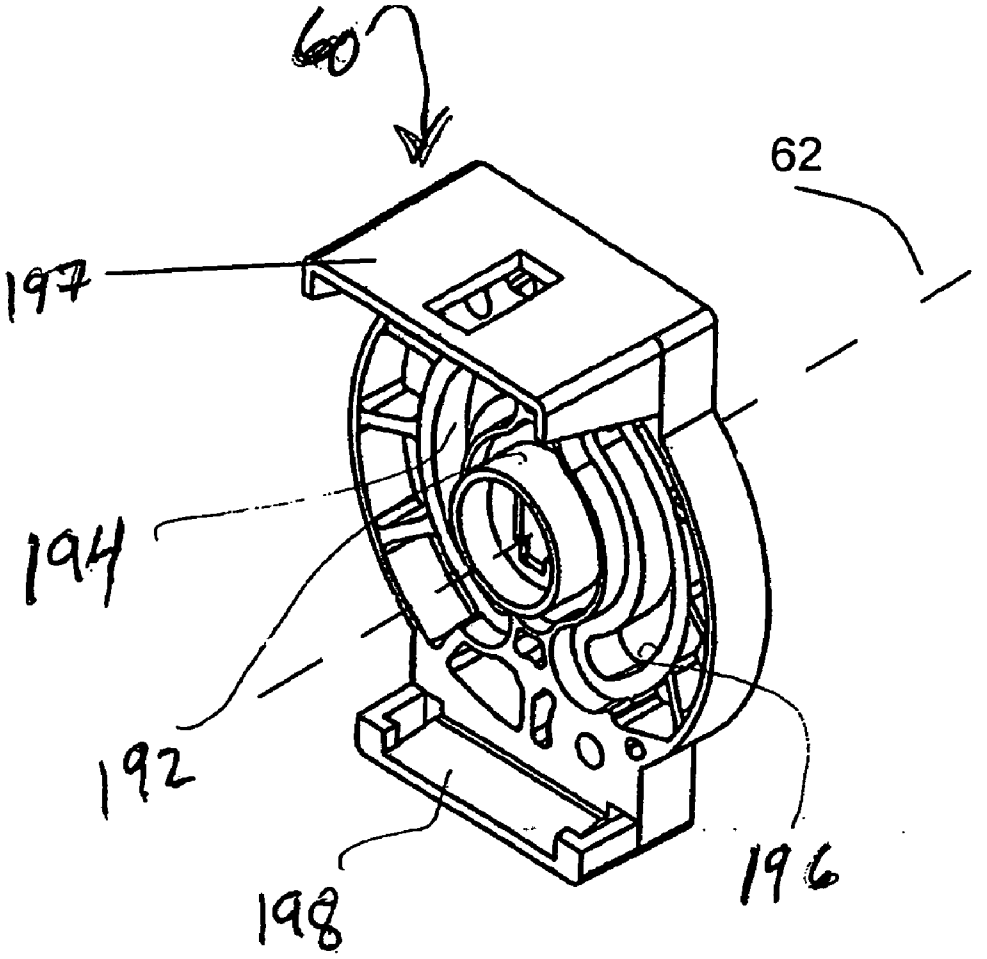



Fig. 7A

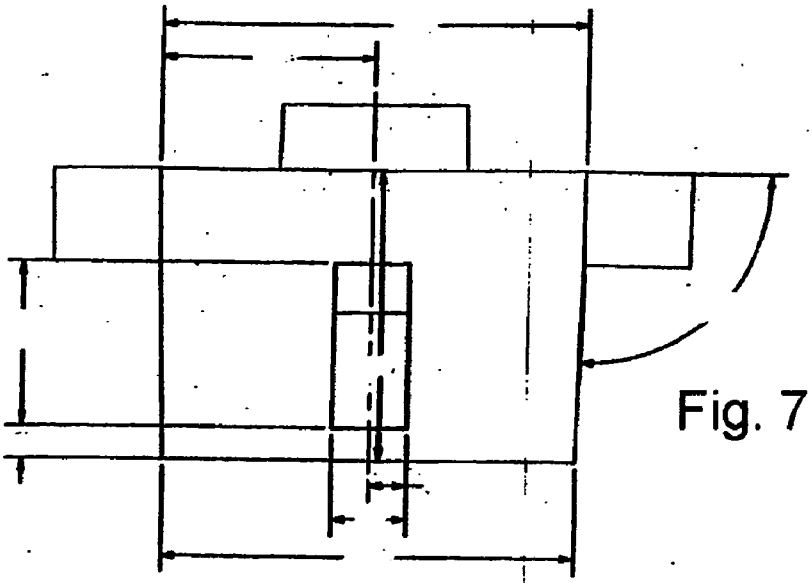


Fig. 7E

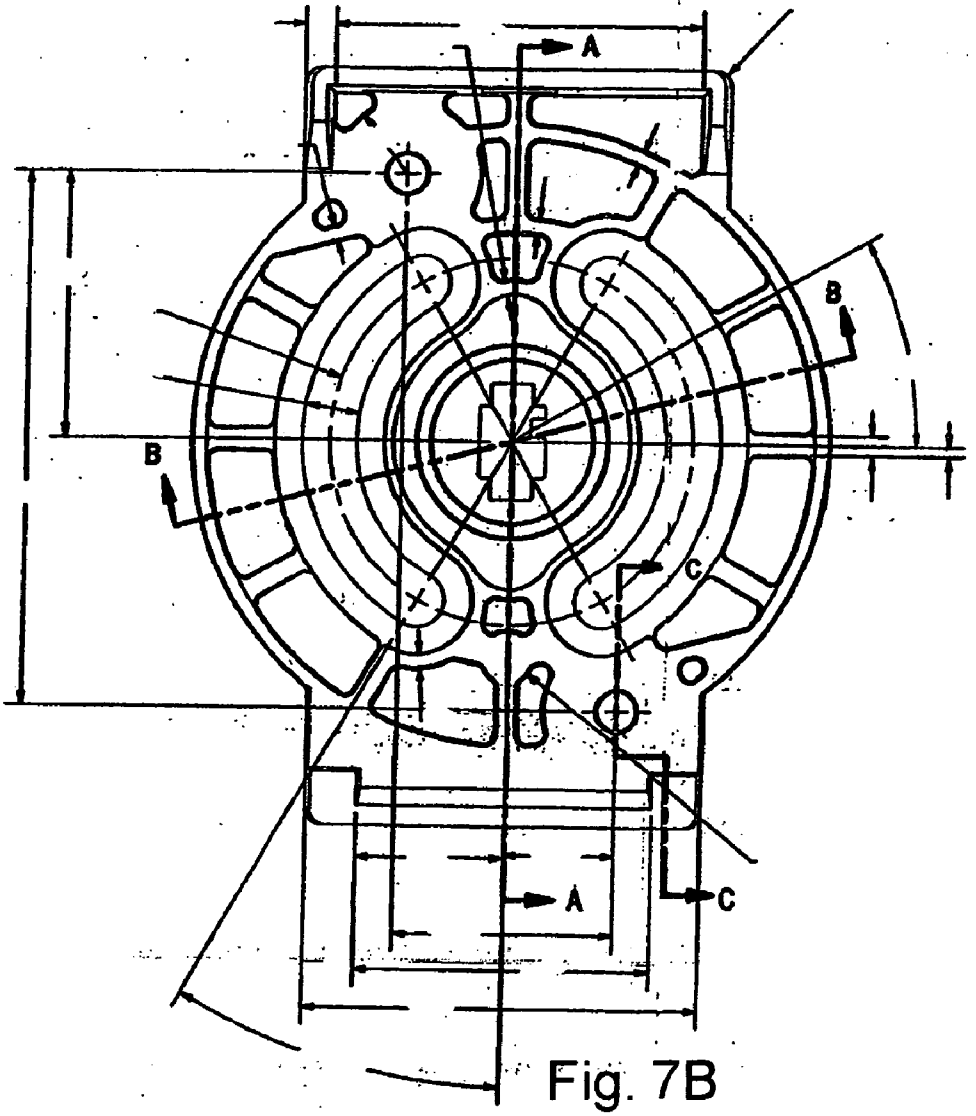



Fig. 7B

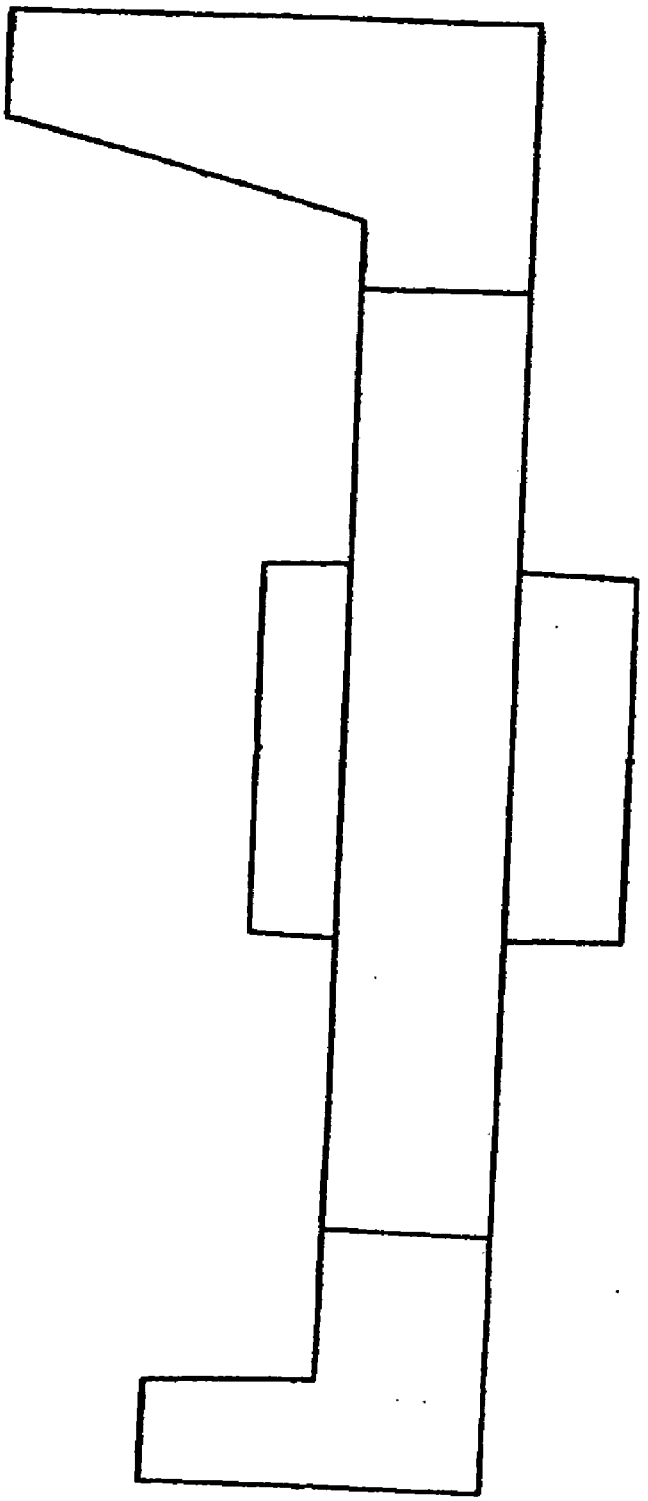


Fig. 7C

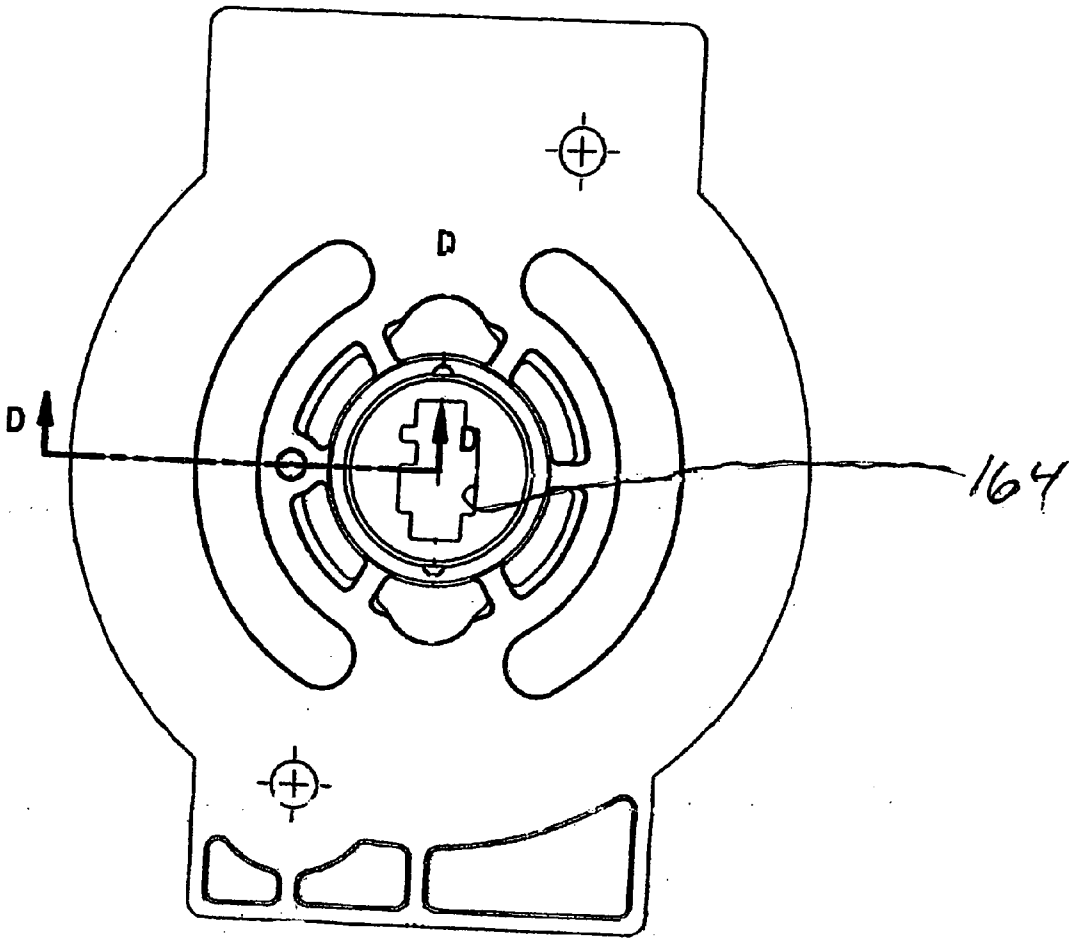



Fig. 7D

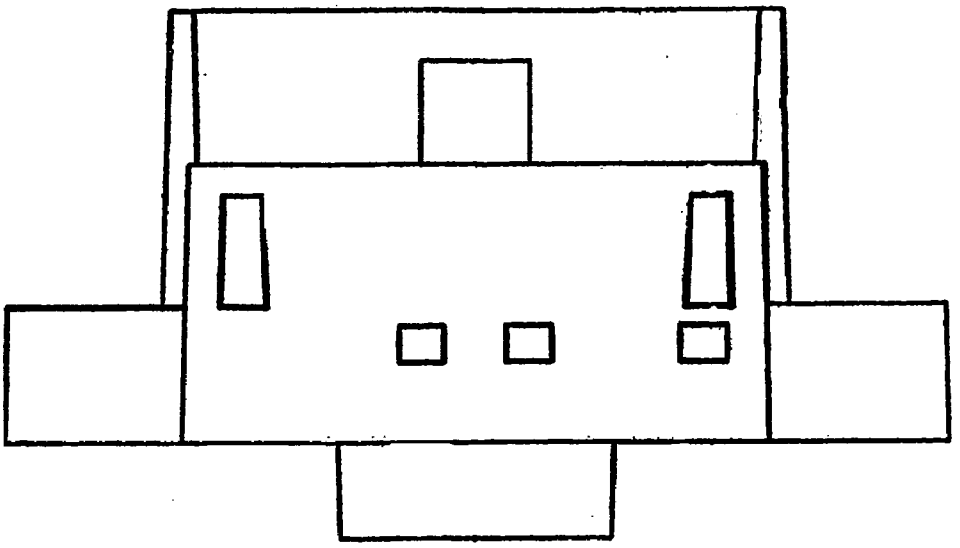


Fig. 7F

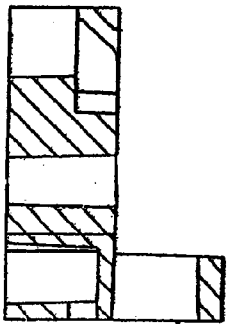


Fig. 7I

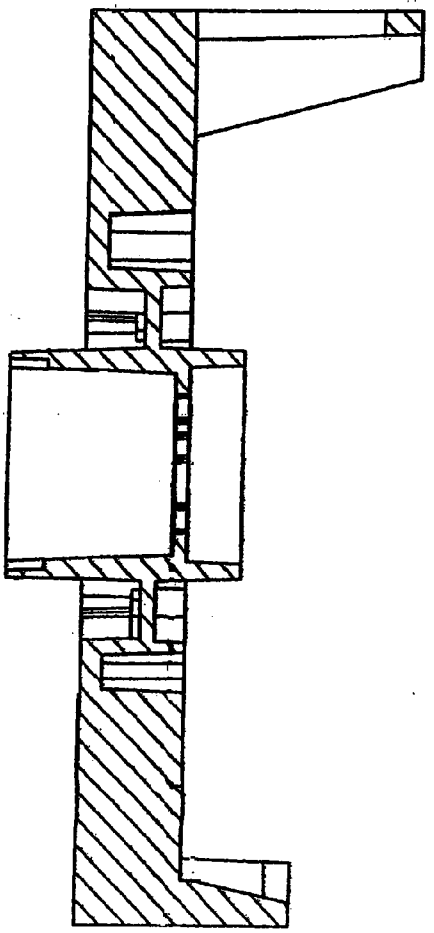


Fig. 7G

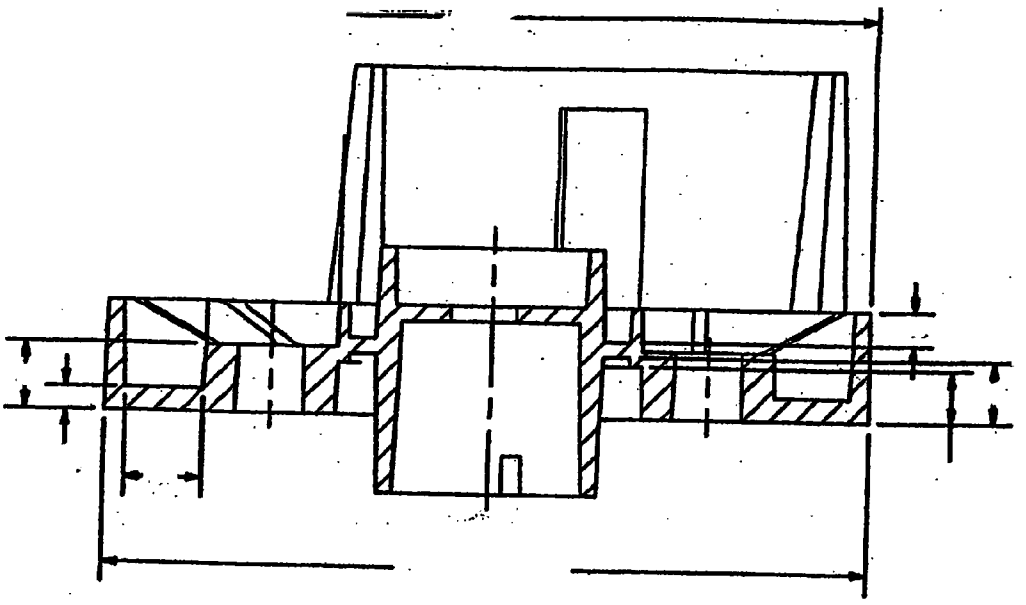


Fig. 7H

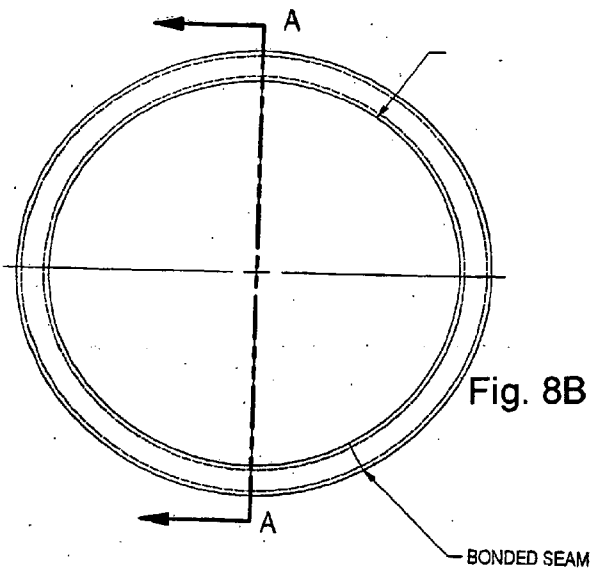
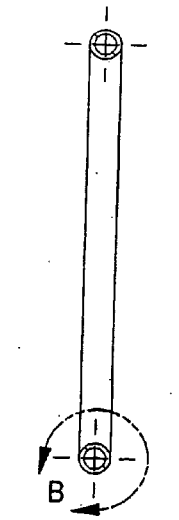
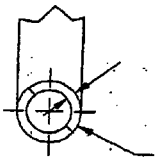



Fig. 8B




SECTION A-A

Fig. 8C



DETAIL B

Fig. 8D

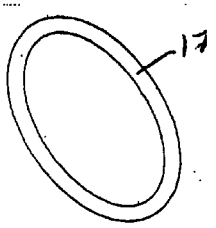



Fig. 8A

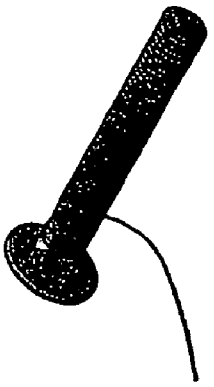



Fig. 9A

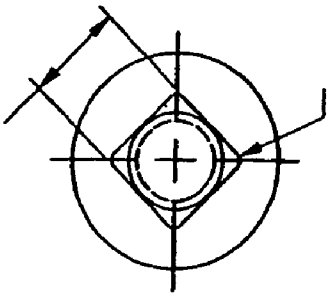


Fig. 9C

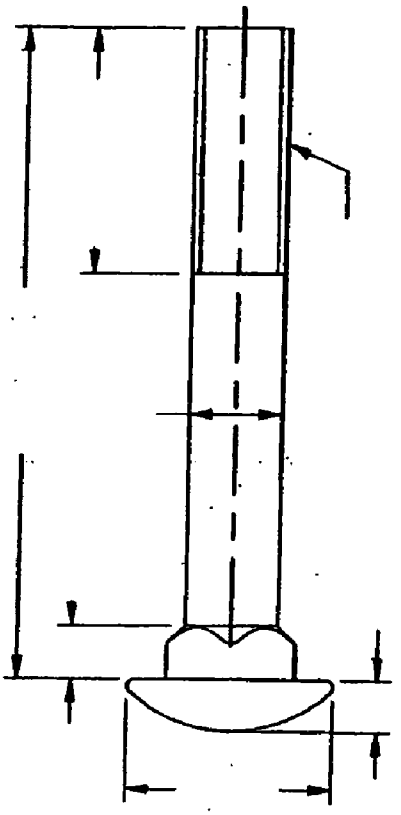


Fig. 9B

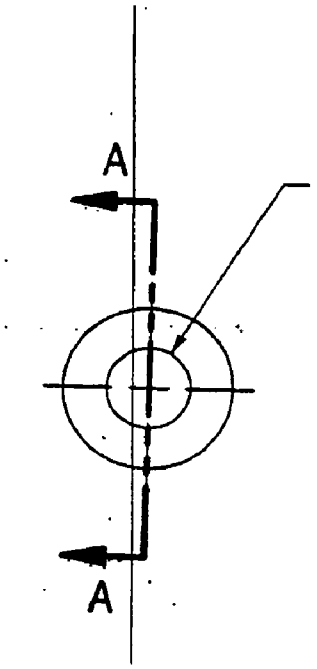
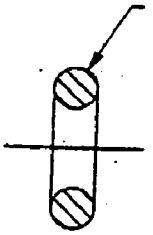



Fig. 10B



SECTION A-A

Fig. 10C

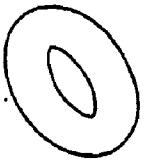


Fig. 10A

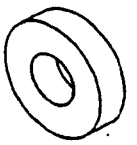


Fig. 11A

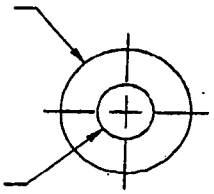


Fig. 11C

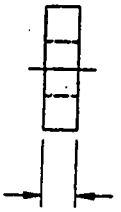


Fig. 11B

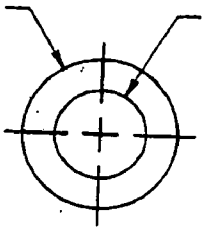


Fig. 12B

Fig. 12C

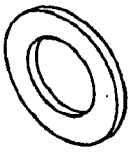


Fig. 12A

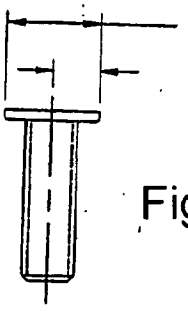


Fig. 13B

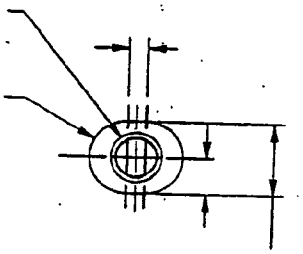


Fig. 13C

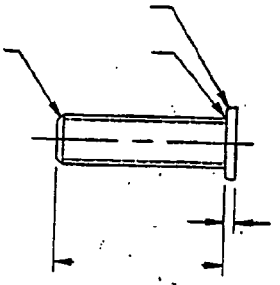


Fig. 13D

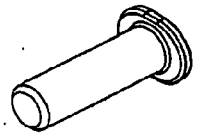


Fig. 13A

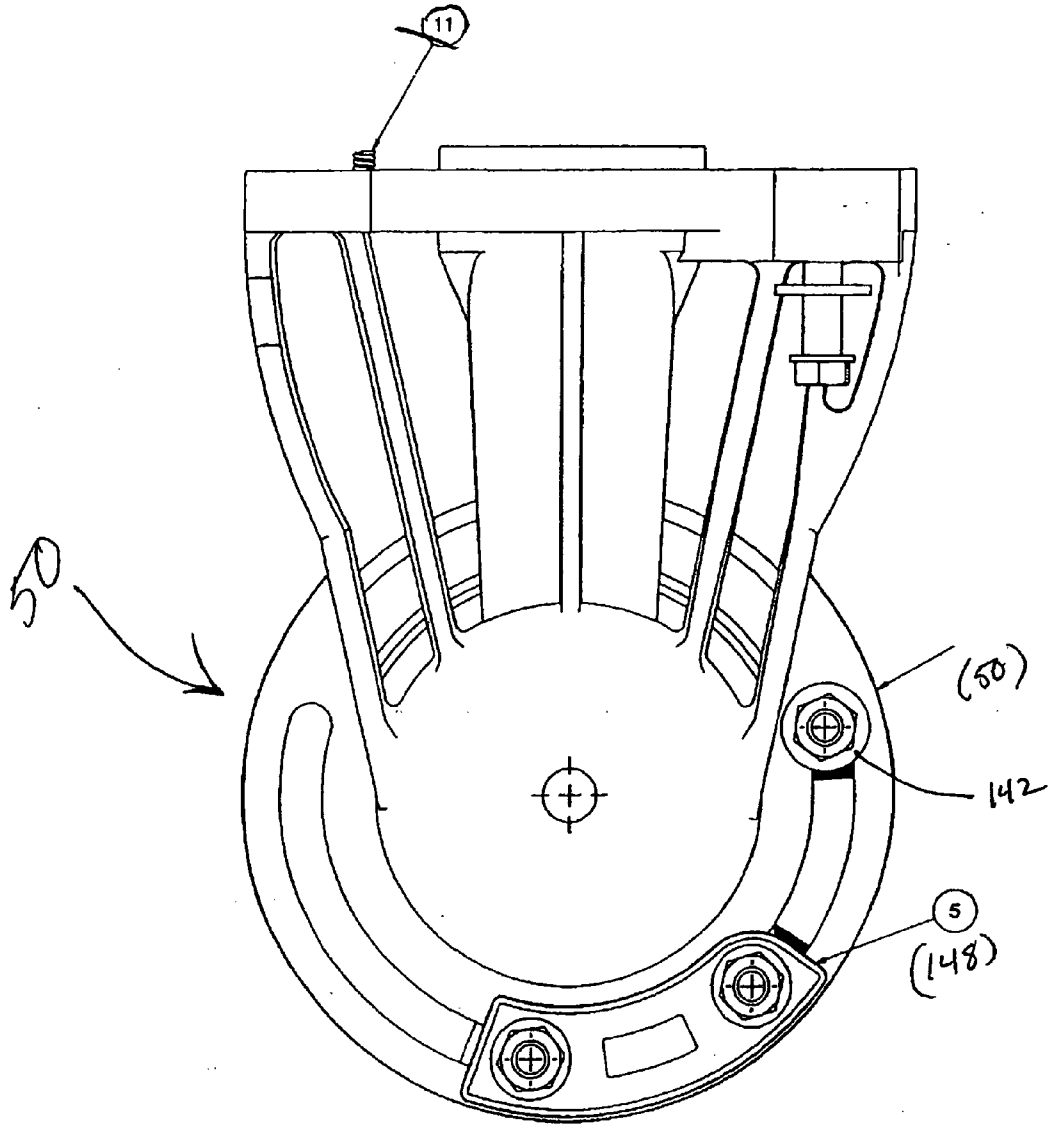



Fig. 14A

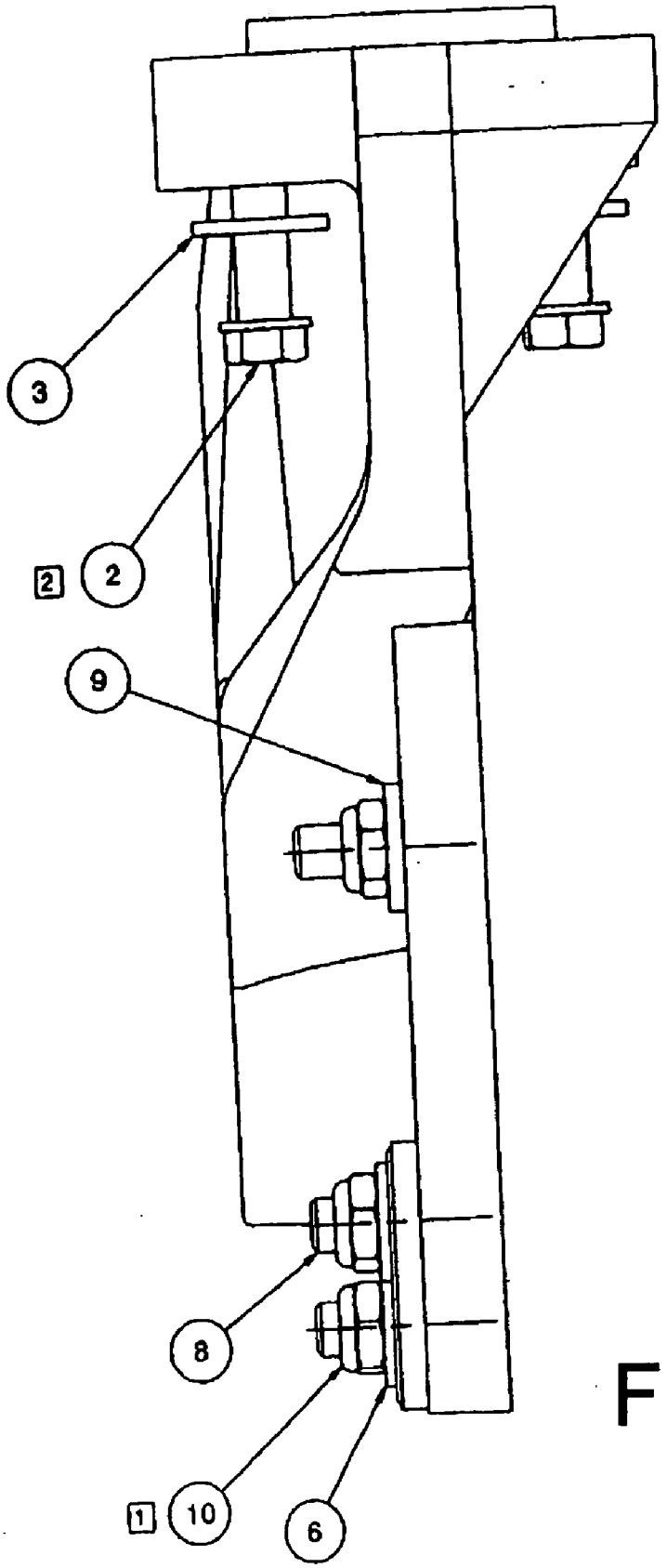



Fig. 14B

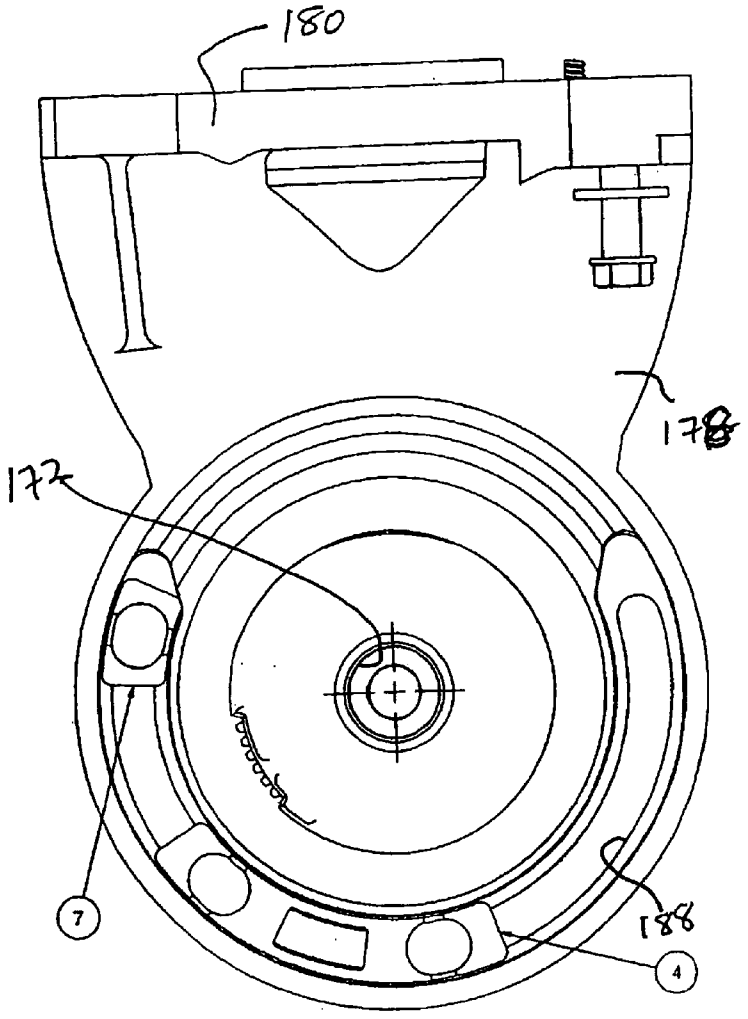



Fig. 14C

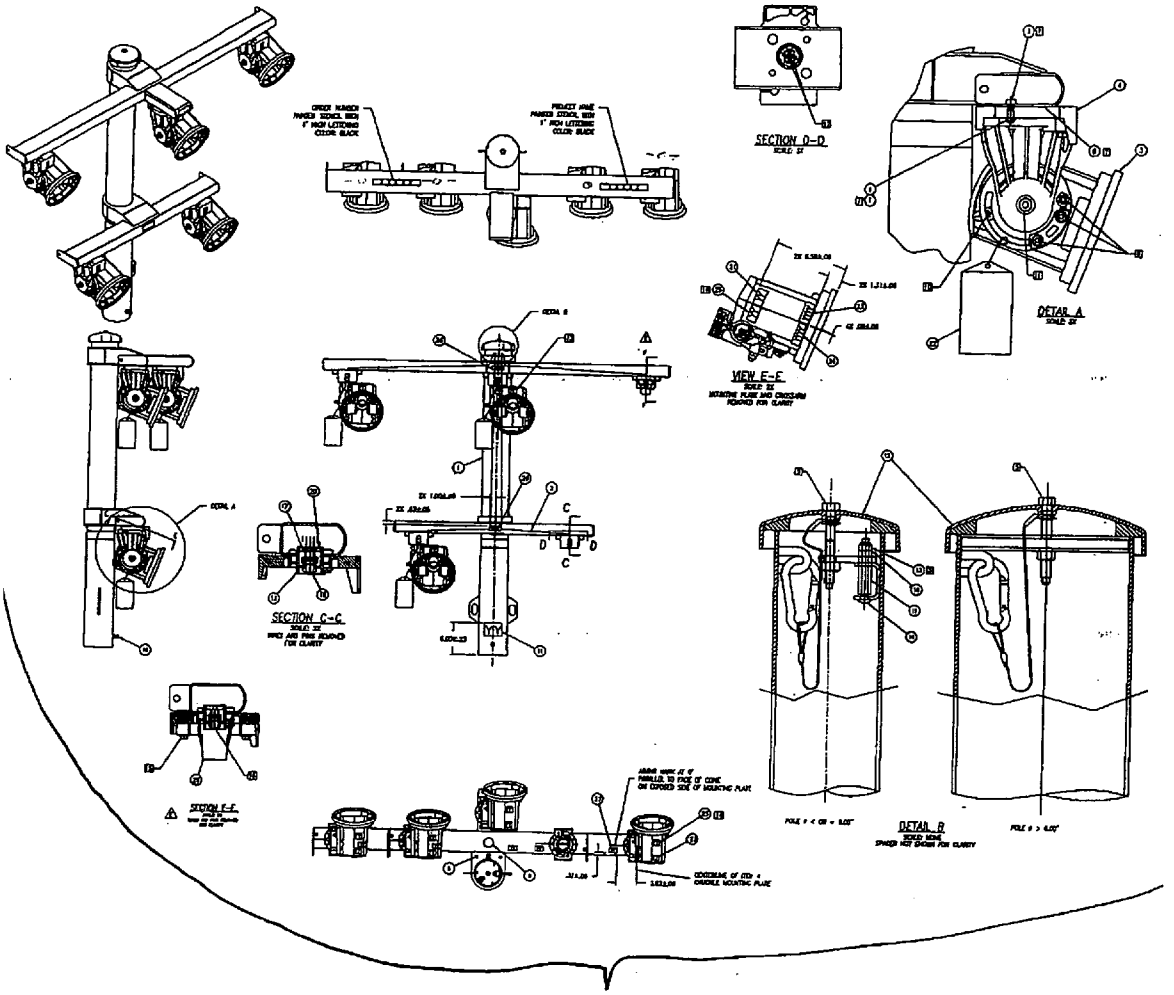



Fig. 14D

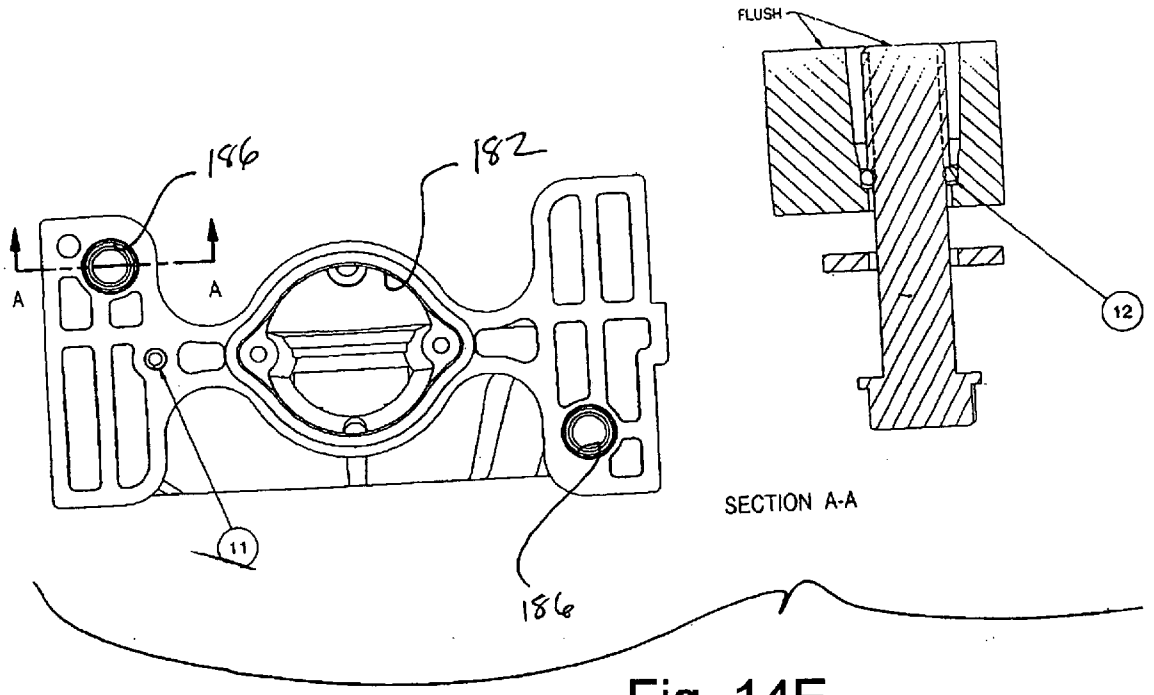



Fig. 14E

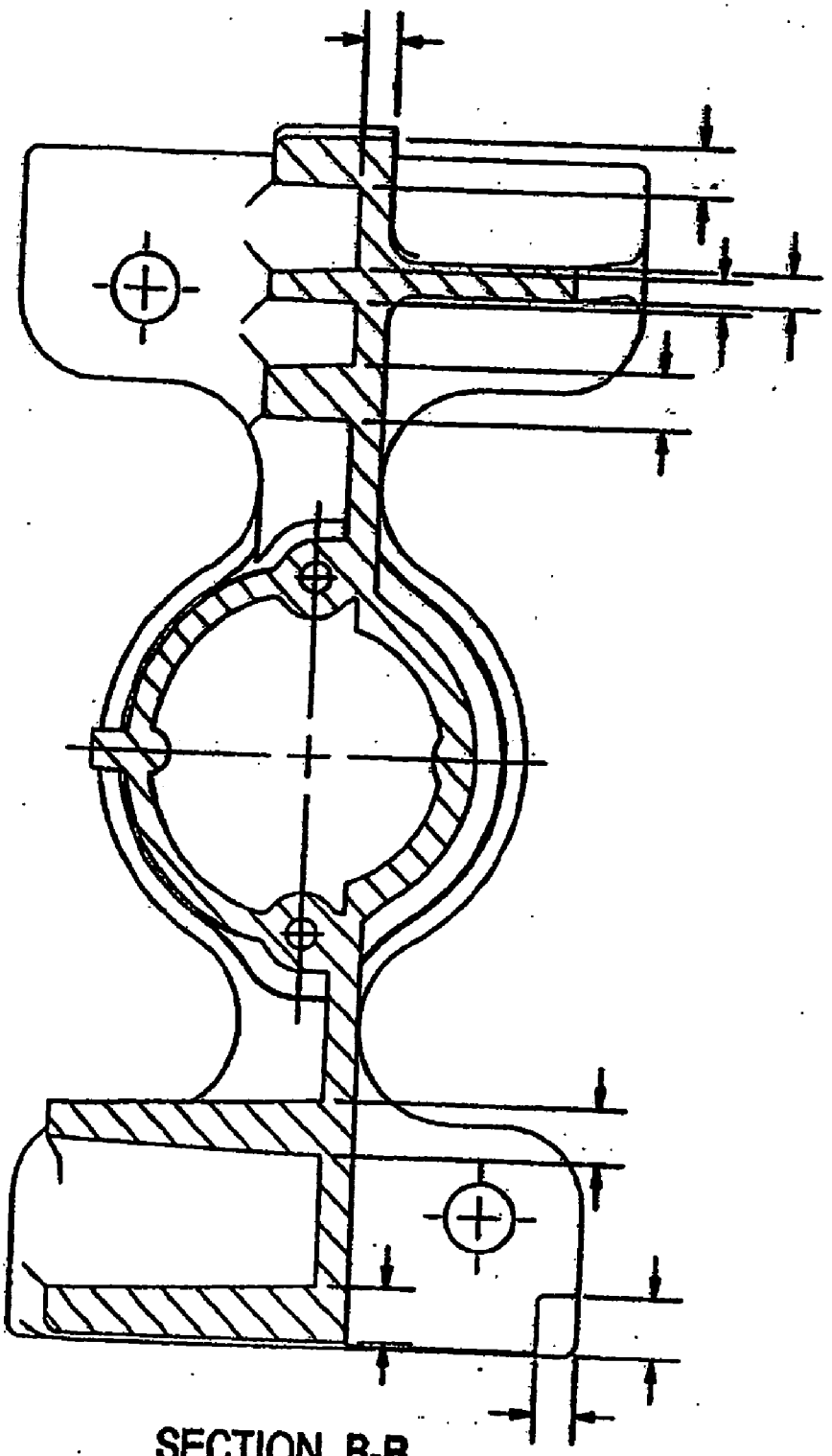



Fig. 14F

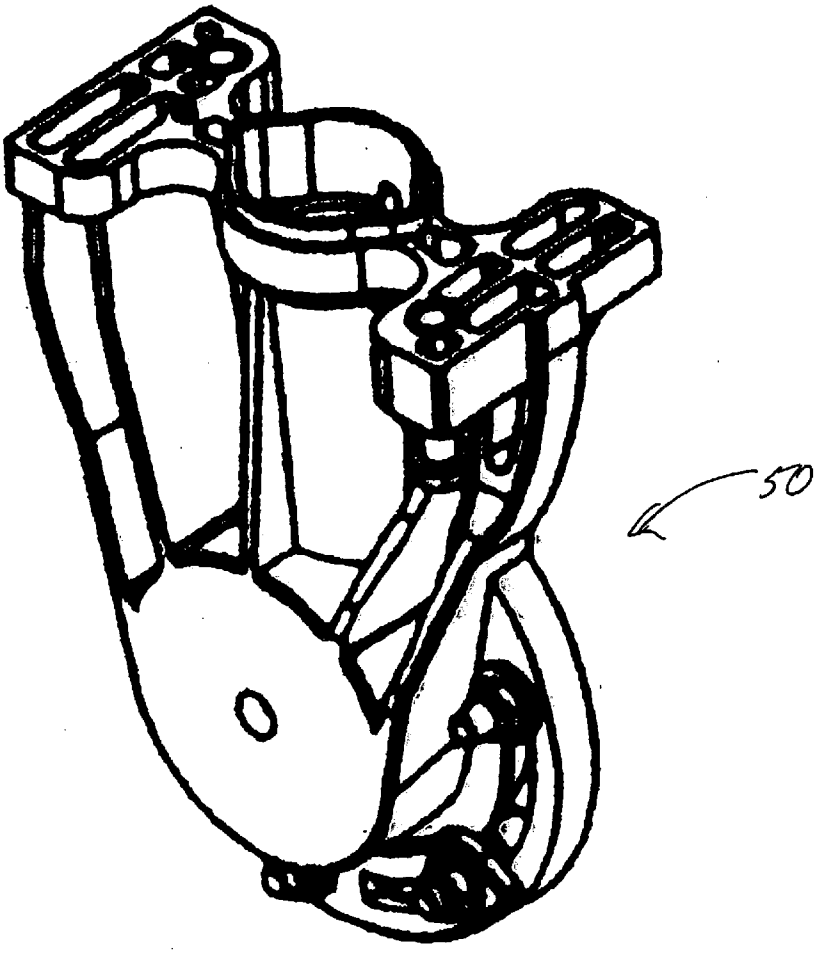



Fig. 14G

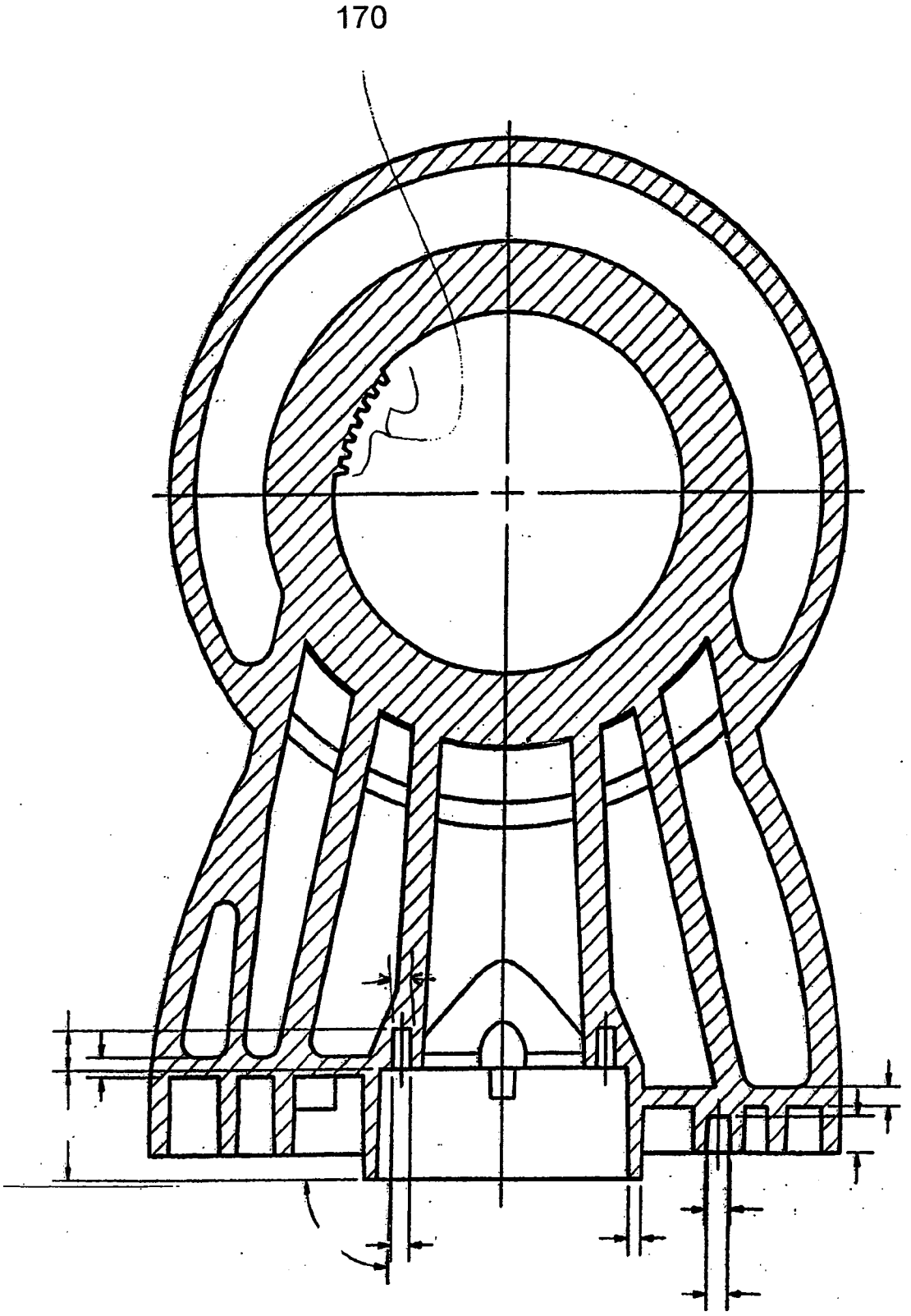



Fig. 14H

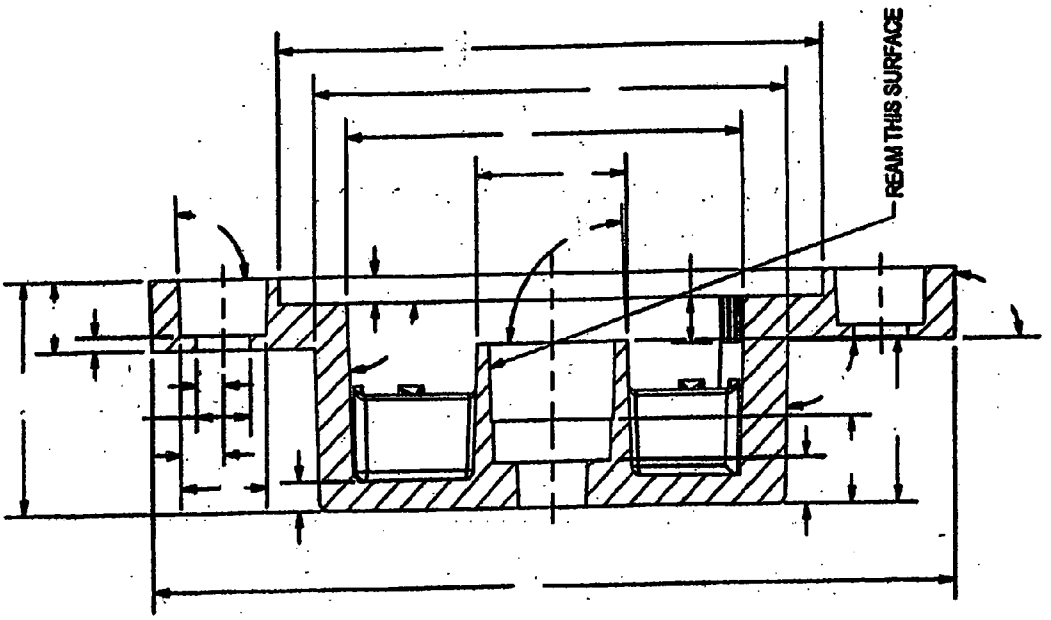



Fig. 14l

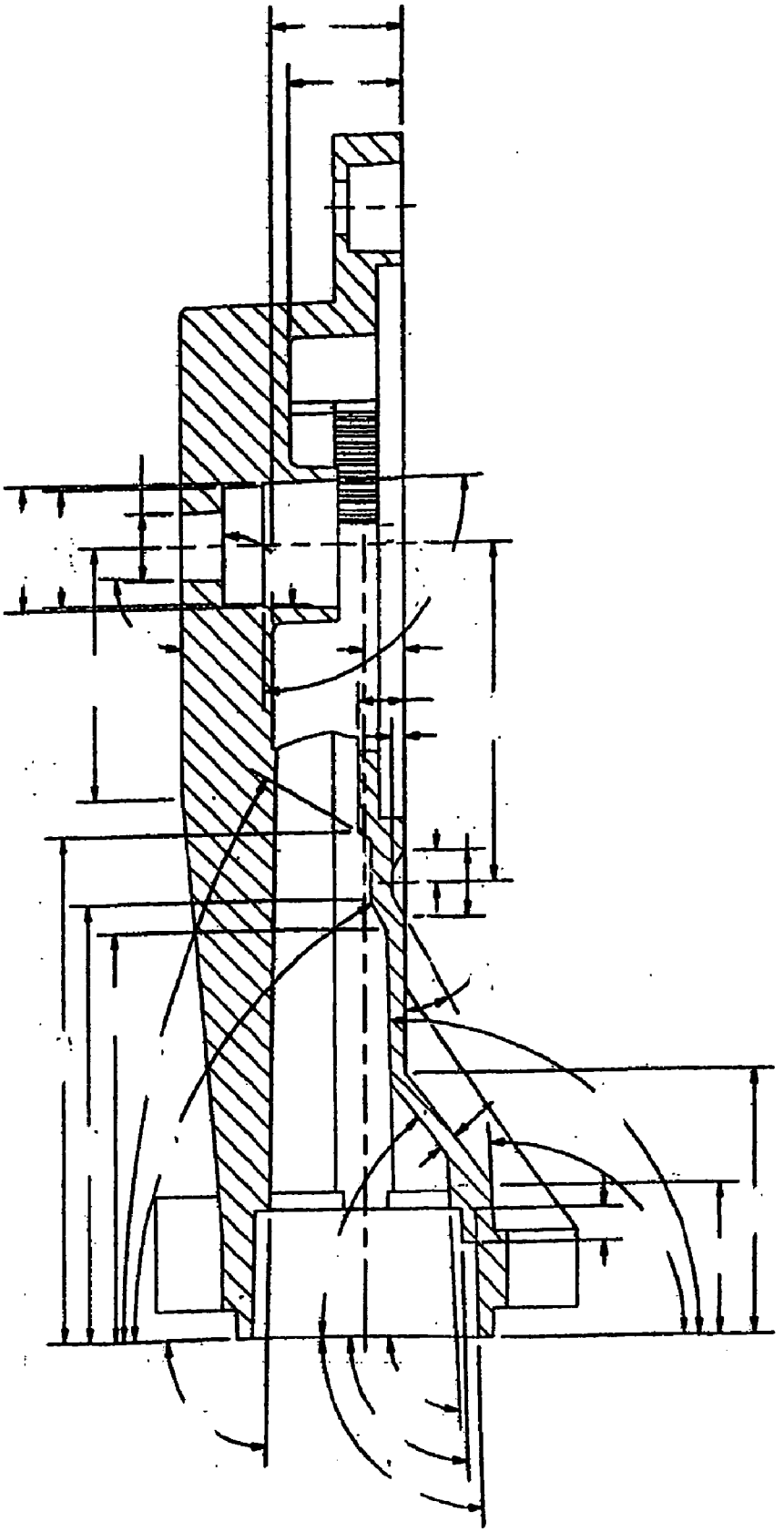


Fig. 14J

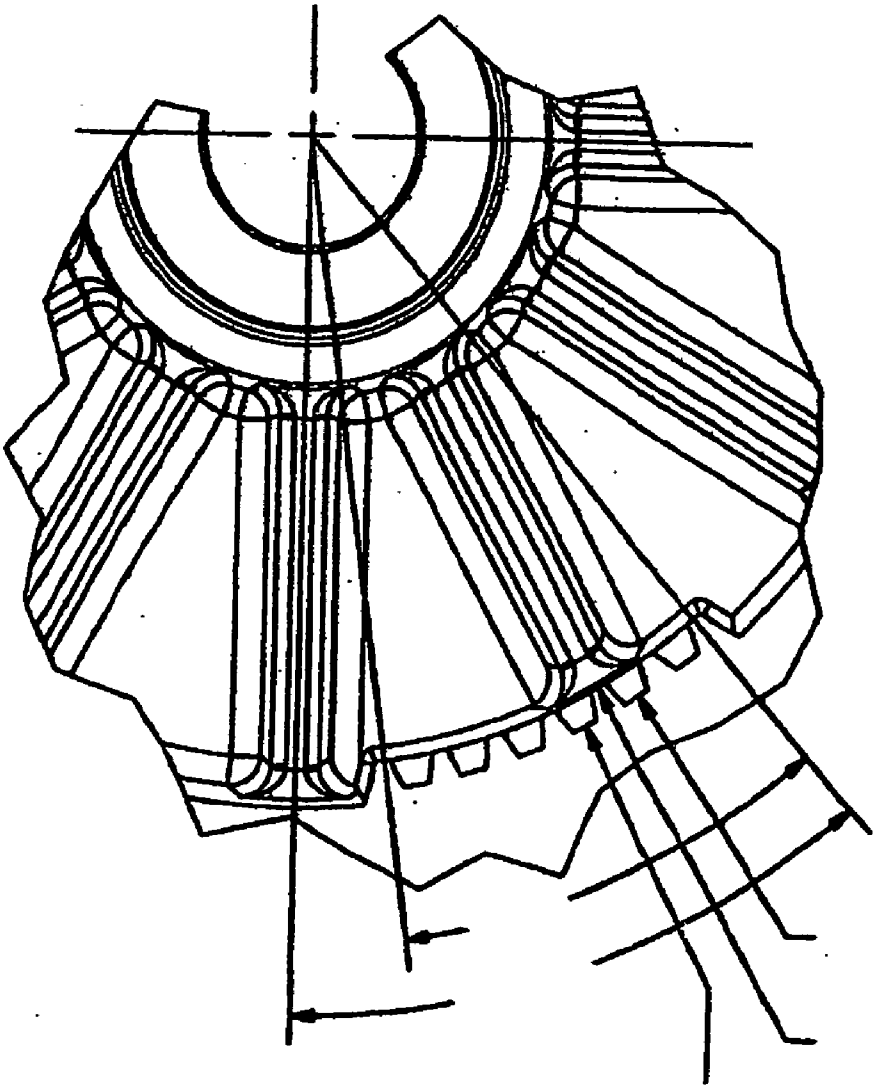
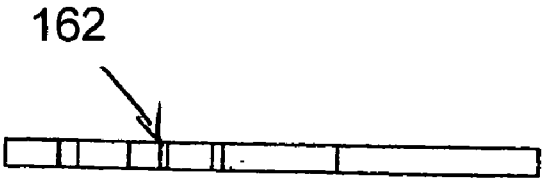


Fig. 14K

Fig. 15B



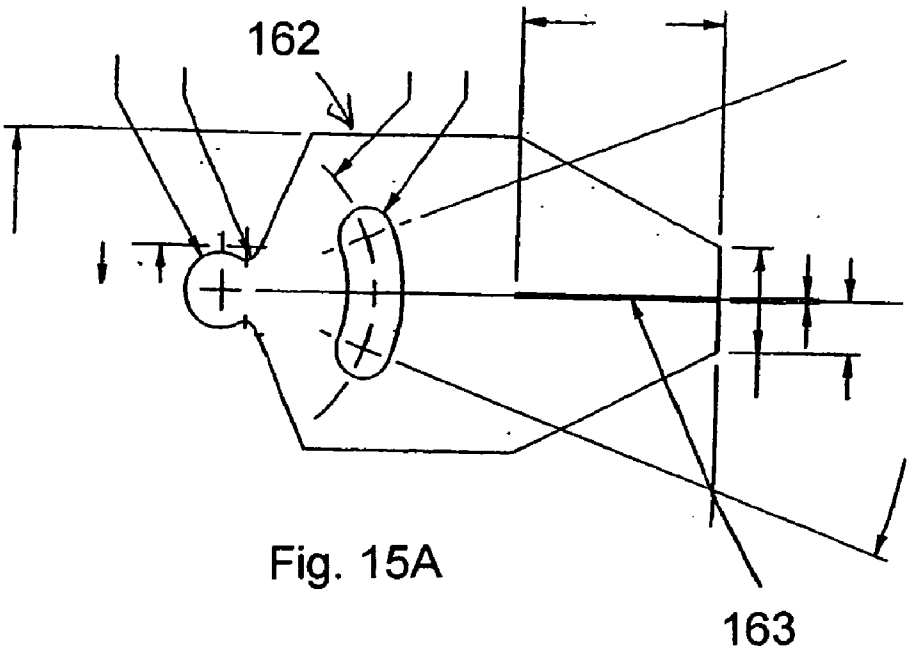




Fig. 15A

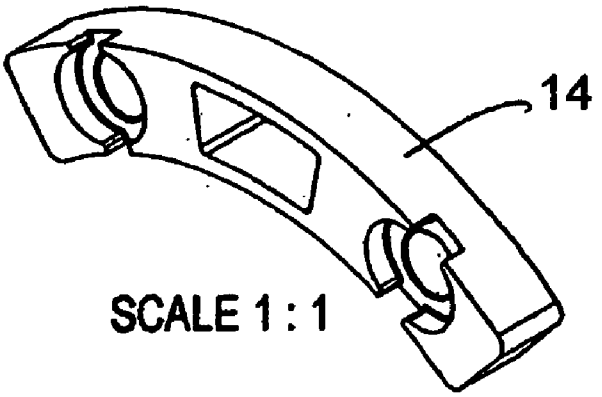



Fig. 16A

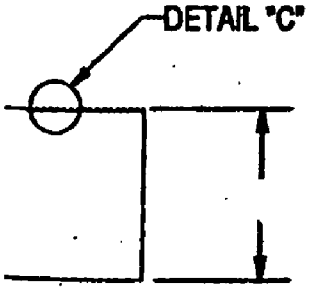



Fig. 15C

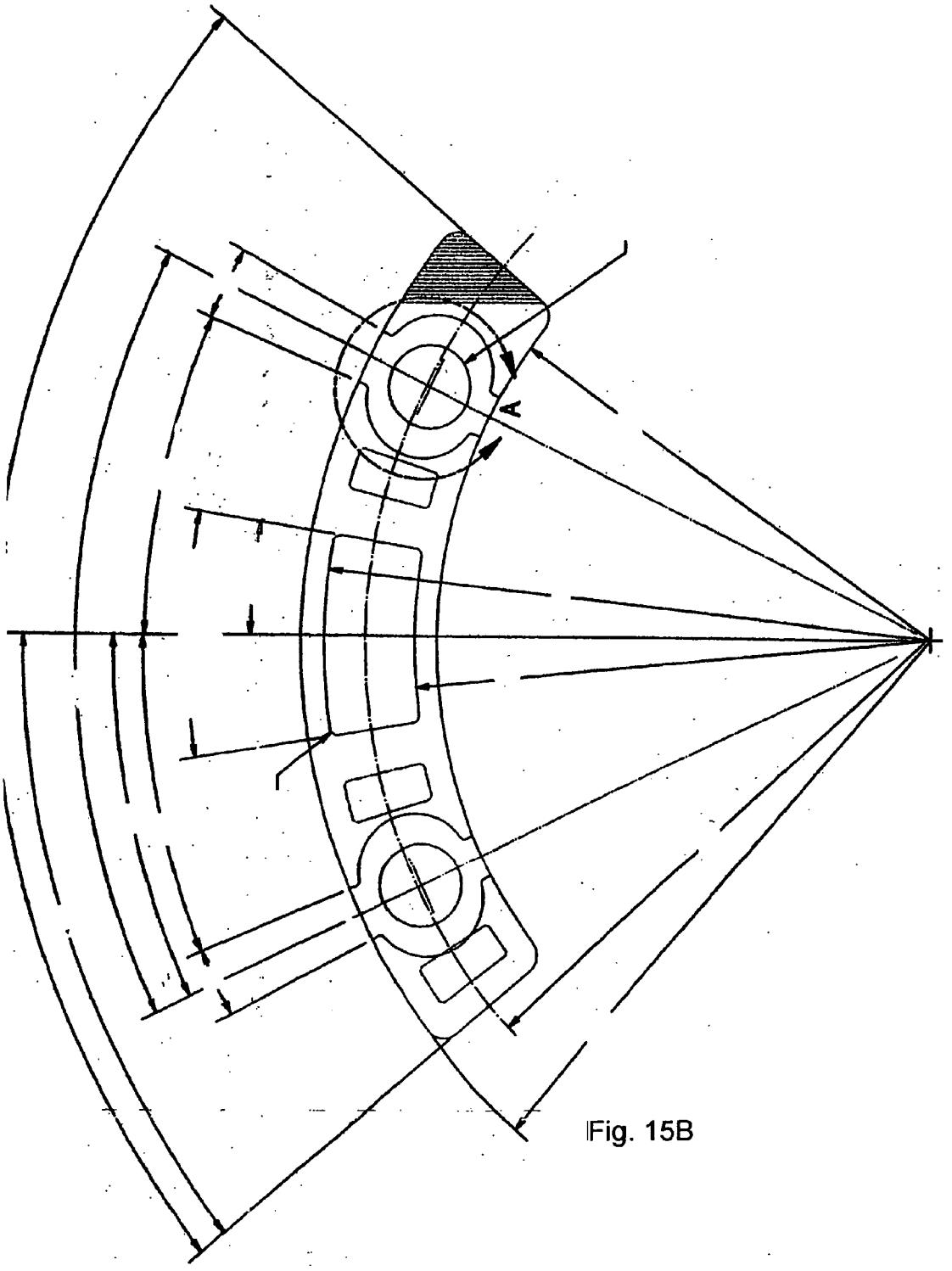


Fig. 15B

Fig. 17F

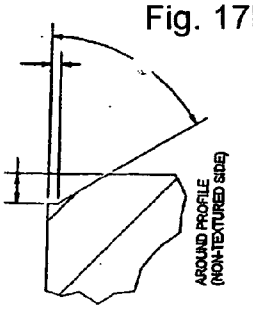



Fig. 17E


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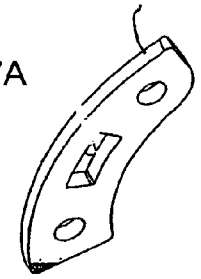
Fig. 17A



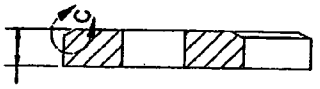



Fig. 17D

Fig. 17C

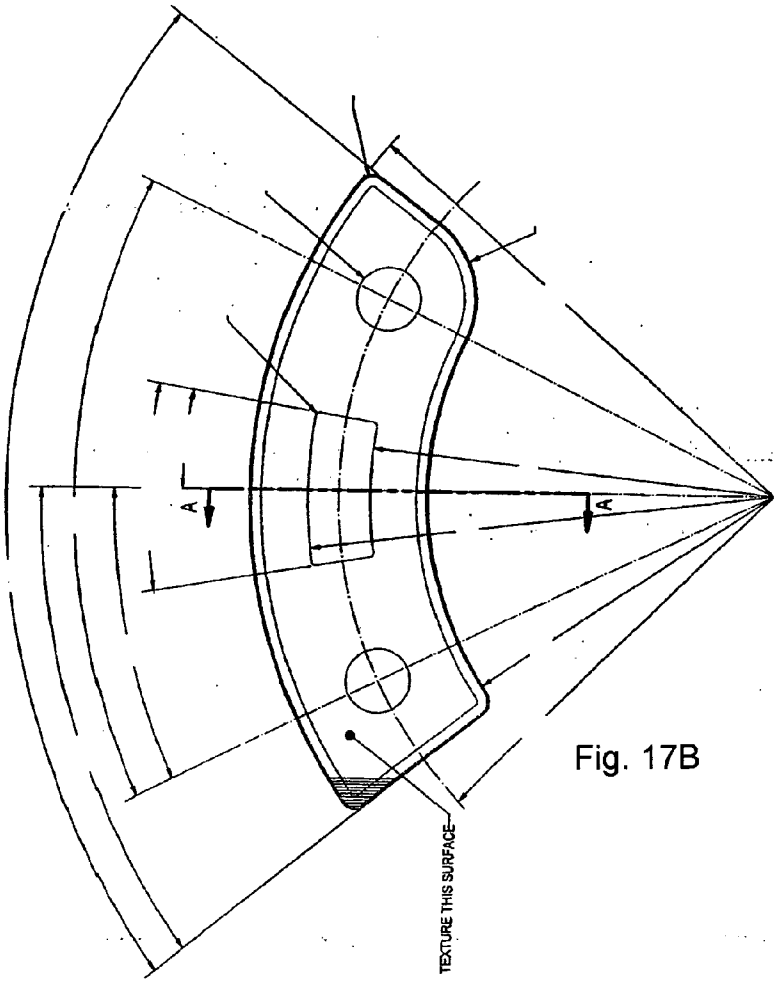




Fig. 17B

142

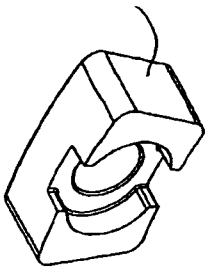
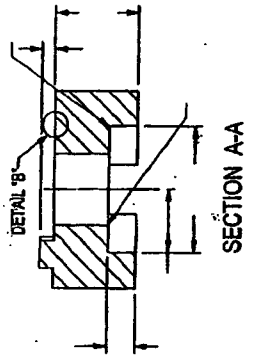


Fig. 18A

Fig. 18E



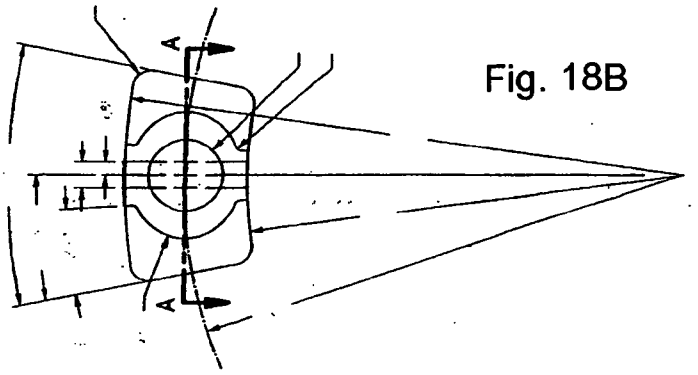




Fig. 18B

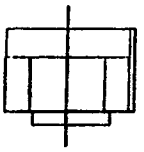
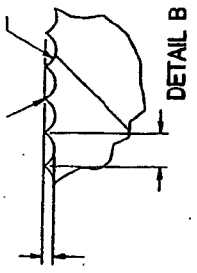


Fig. 18C

Fig. 18F



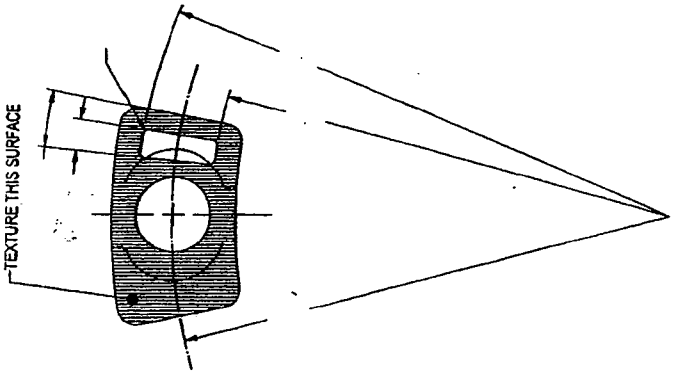




Fig. 18D

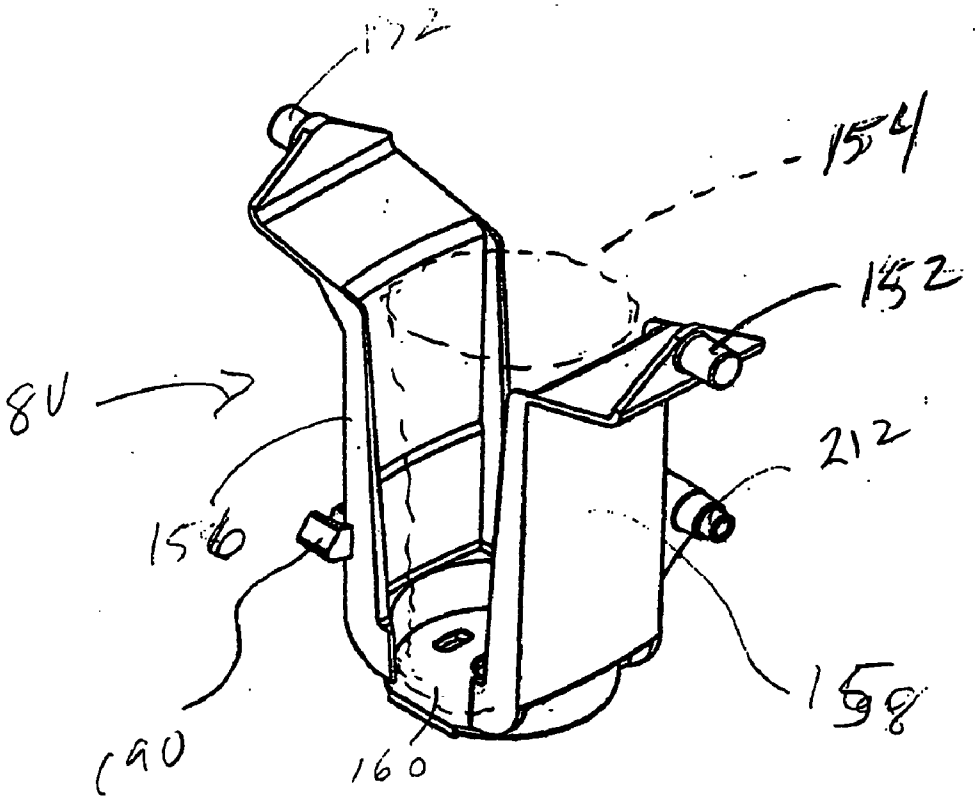



Fig. 19A

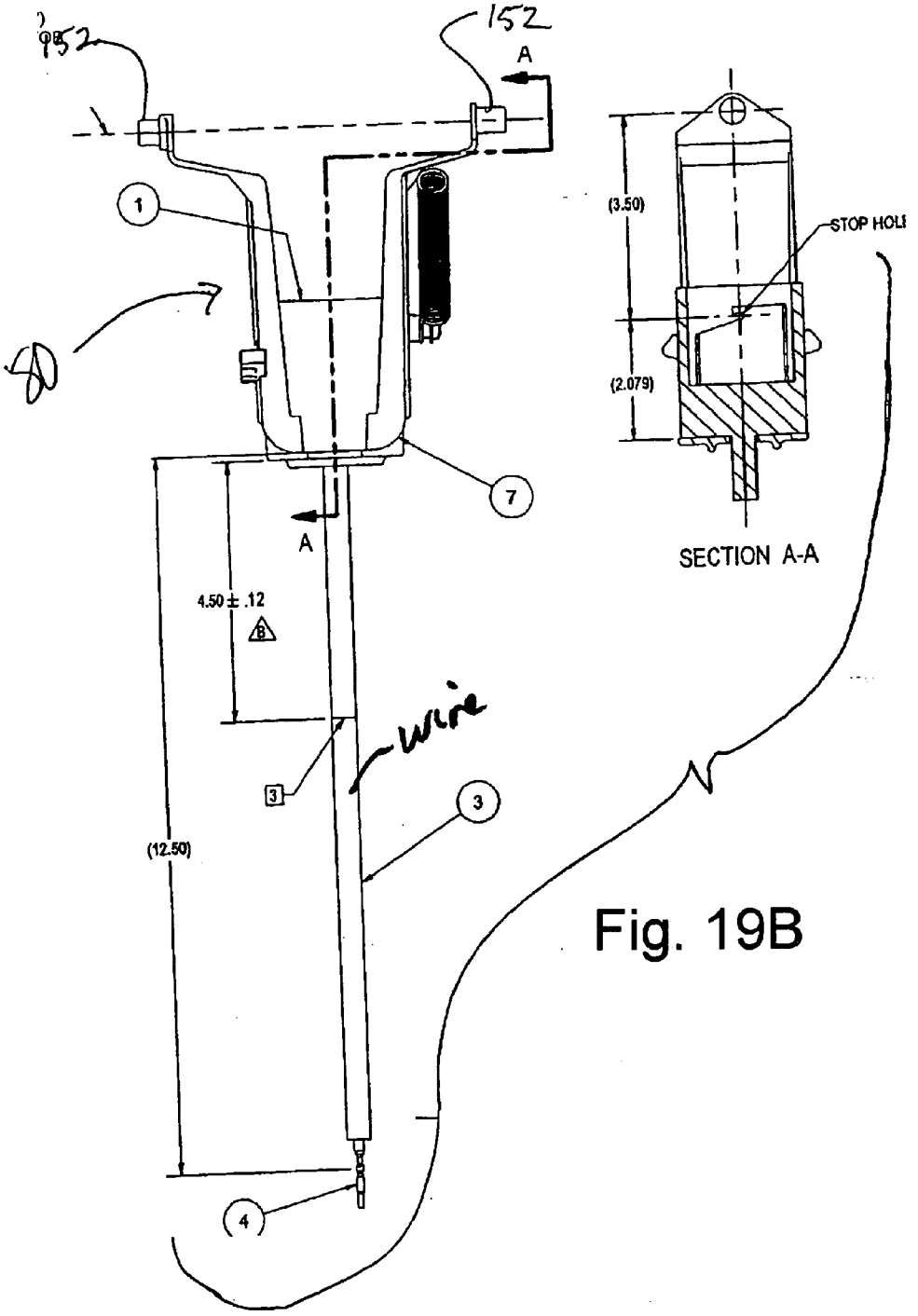



Fig. 19B

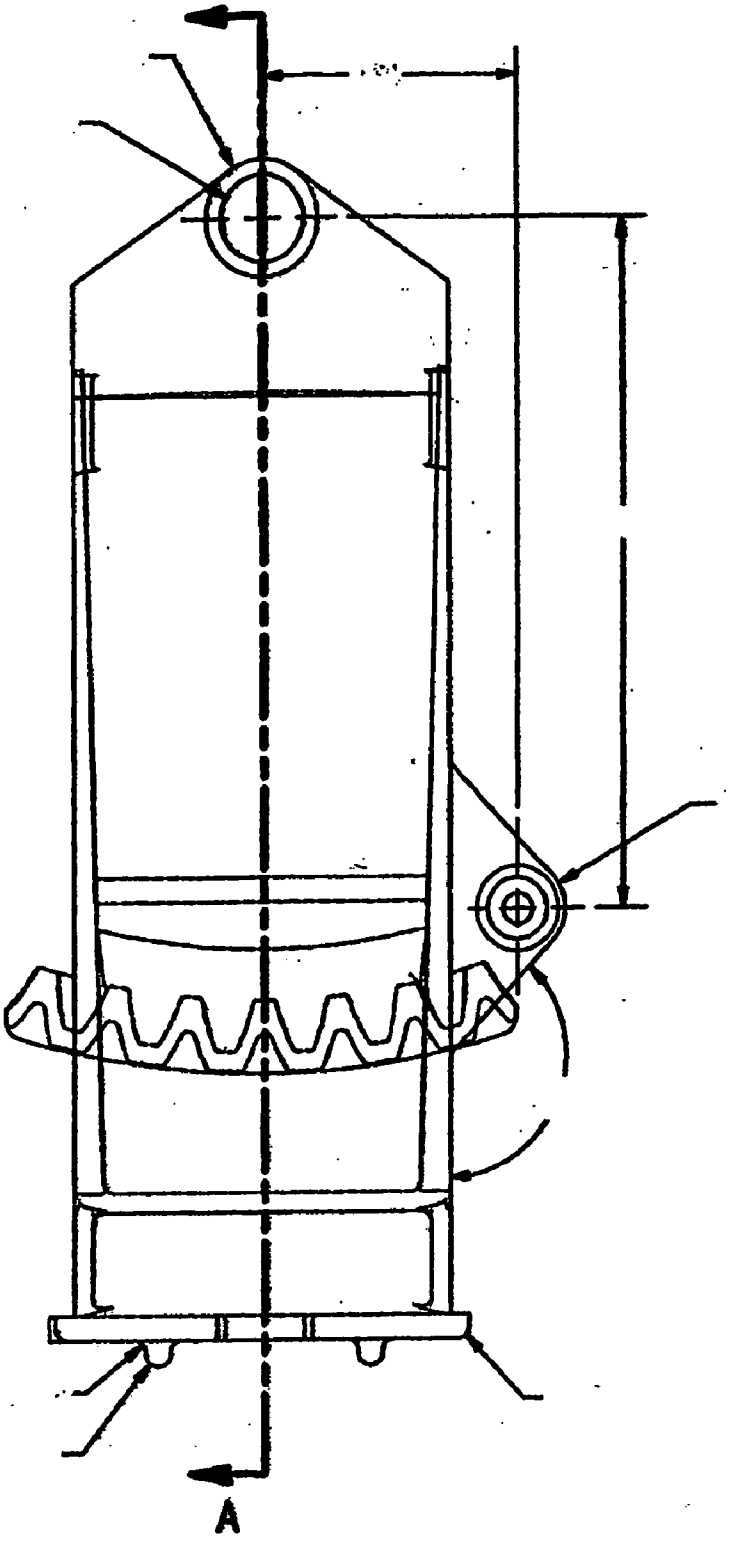



Fig. 19C

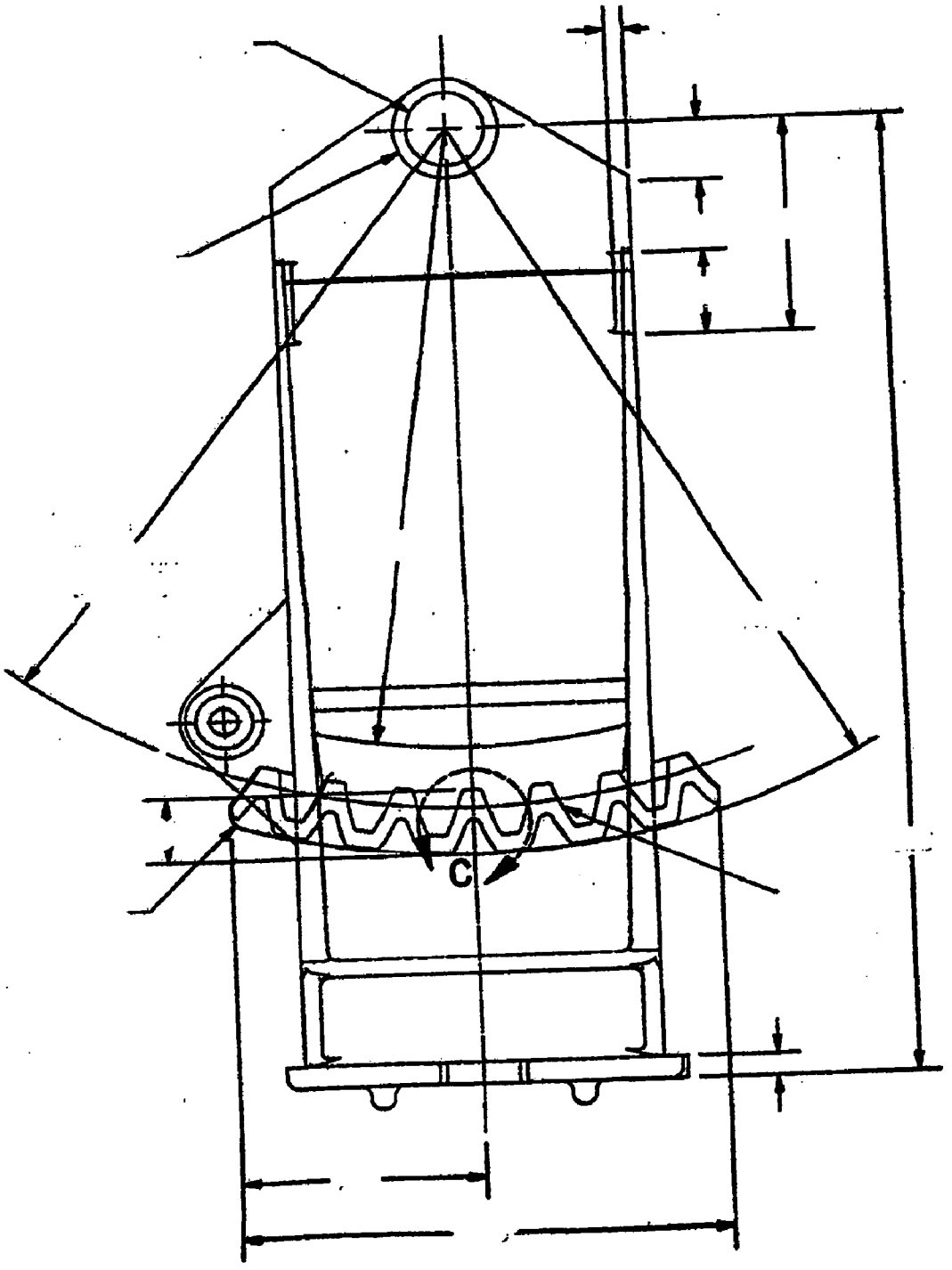



Fig. 19D

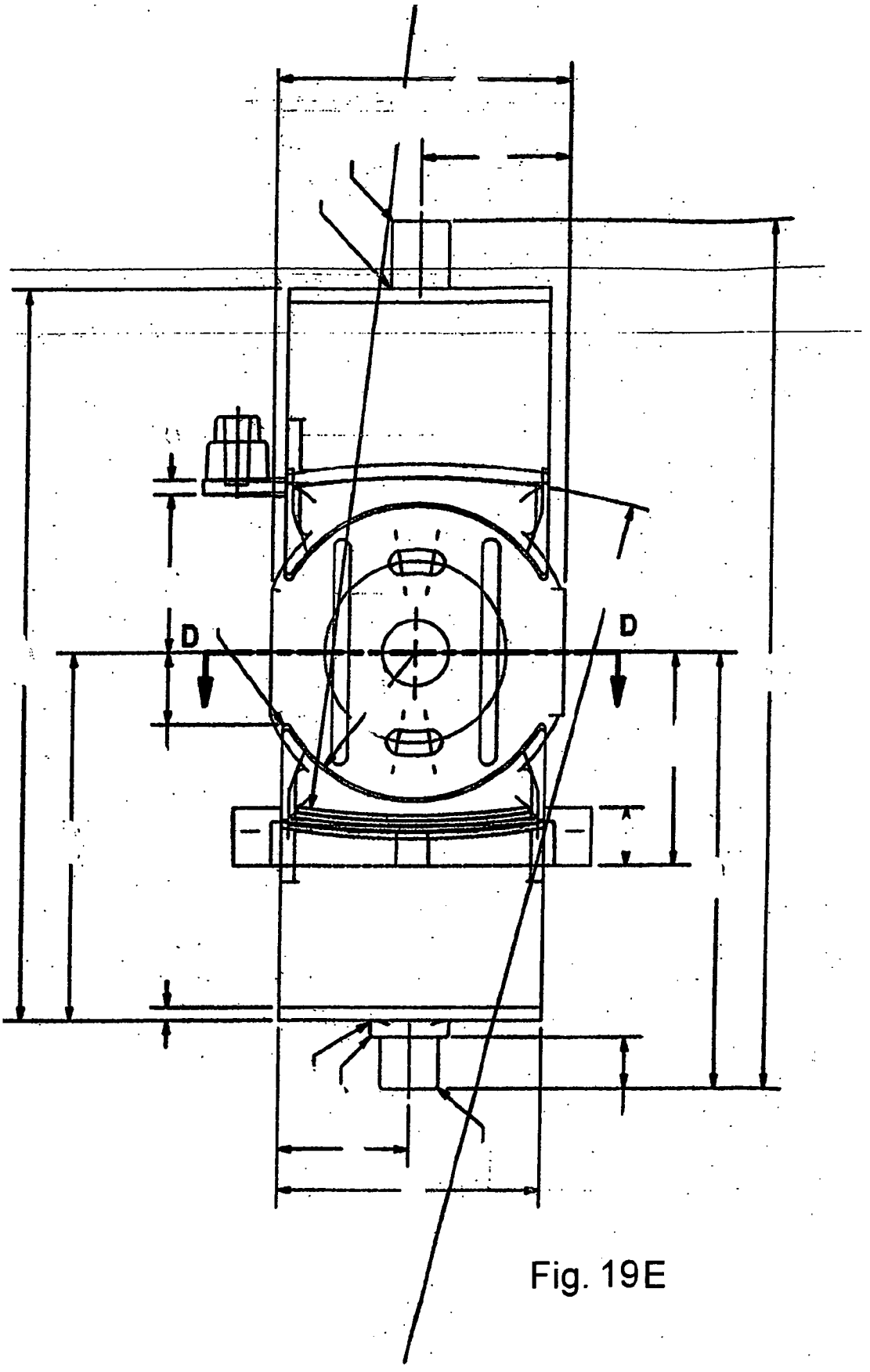



Fig. 19E

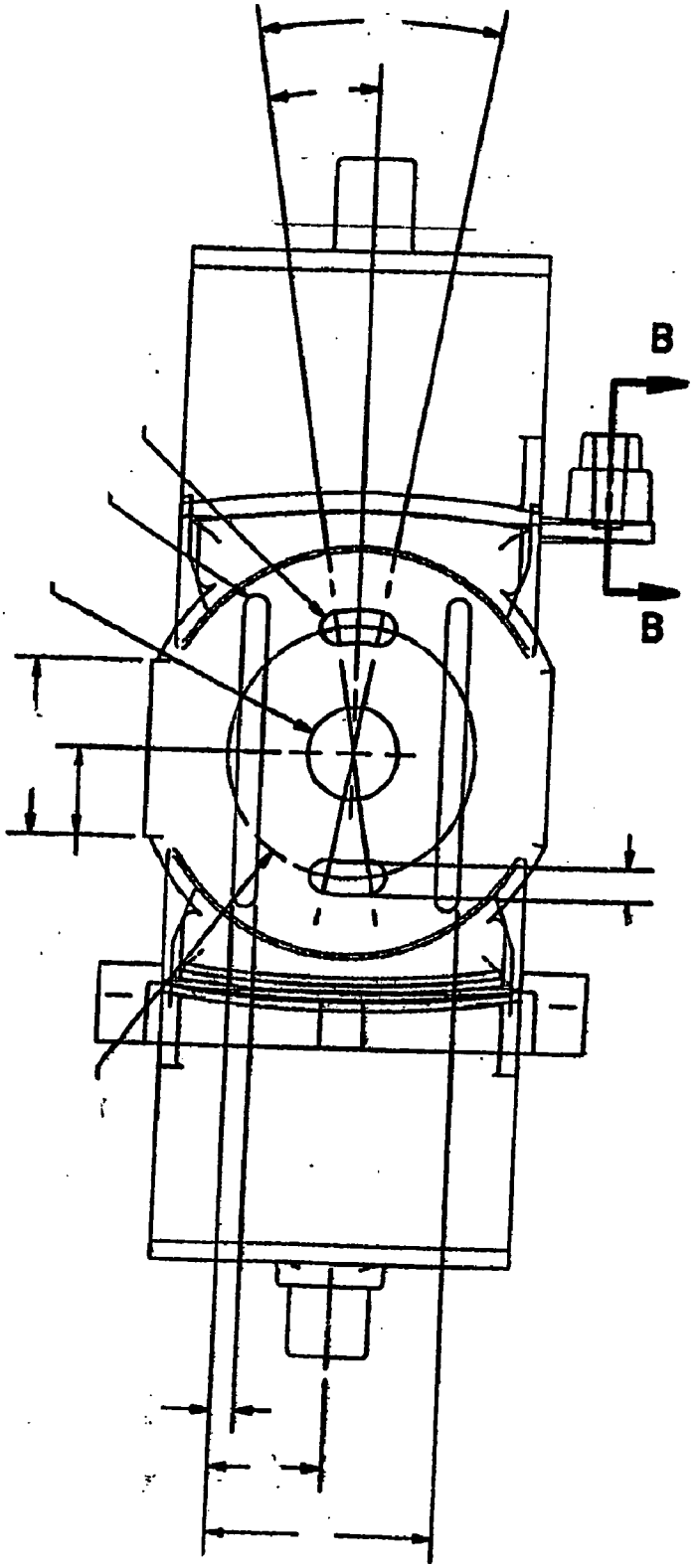



Fig. 19F

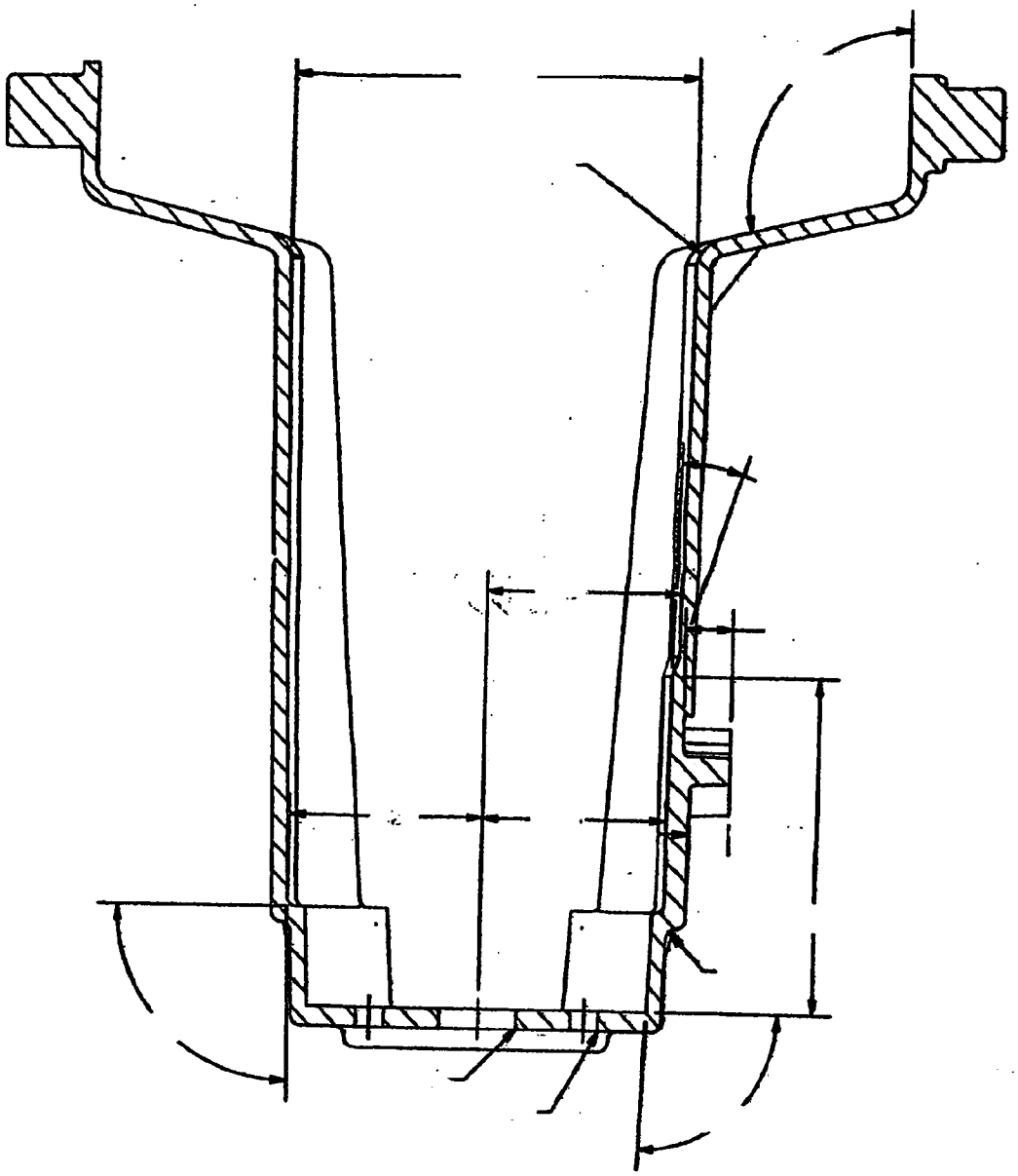


Fig. 19G

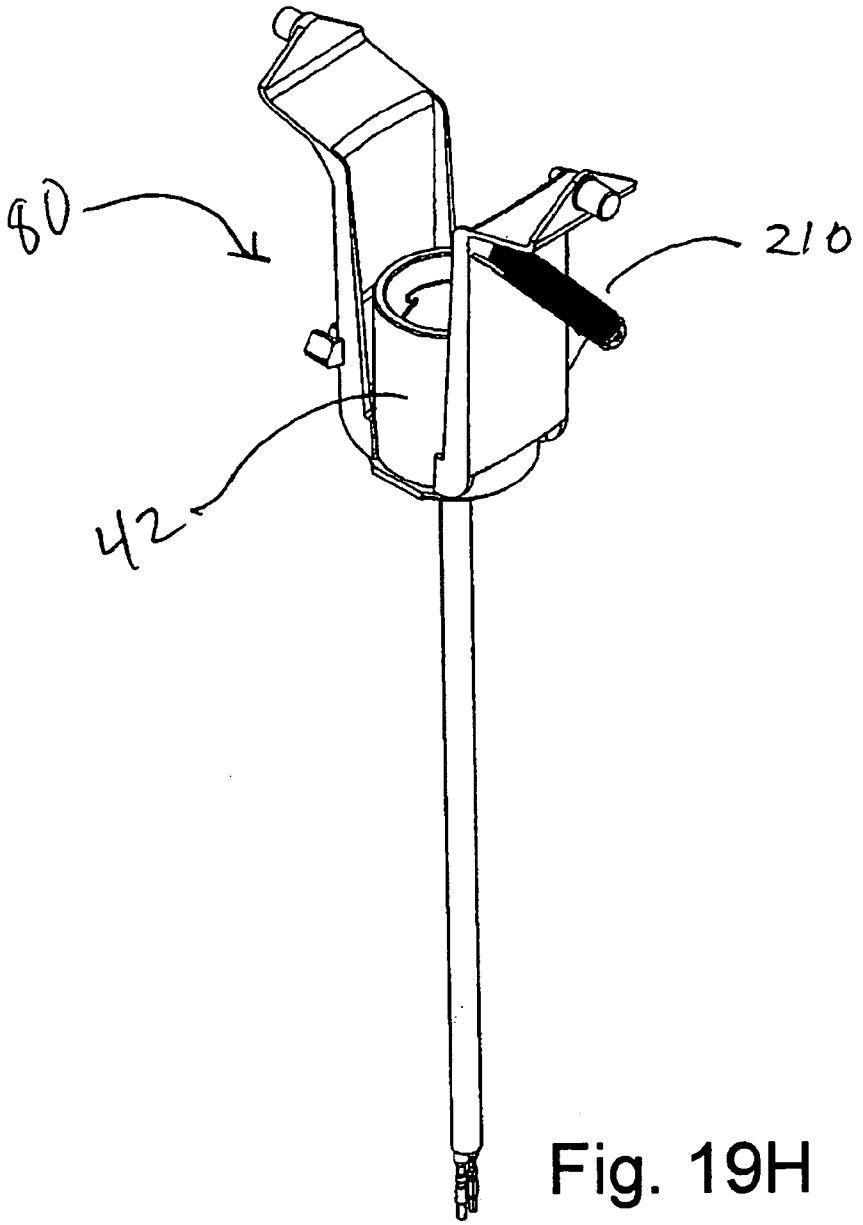



Fig. 19H

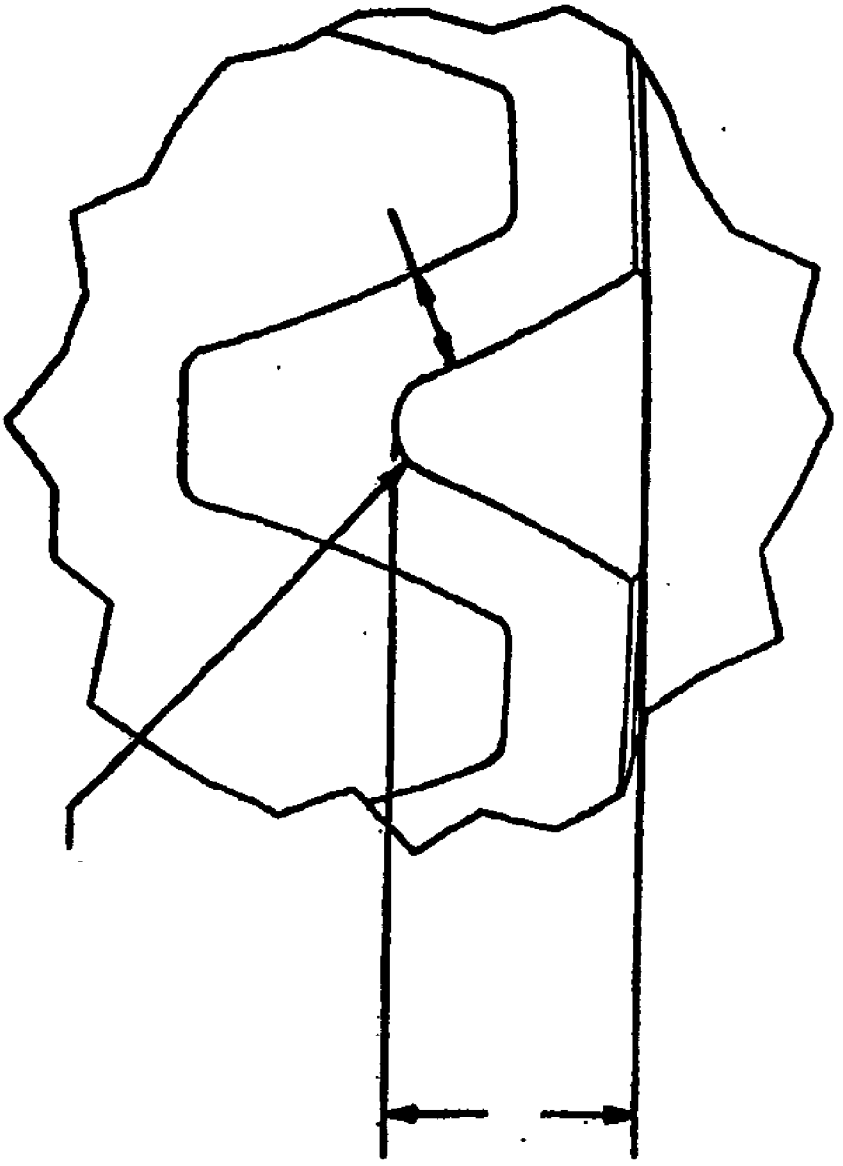


Fig. 19I

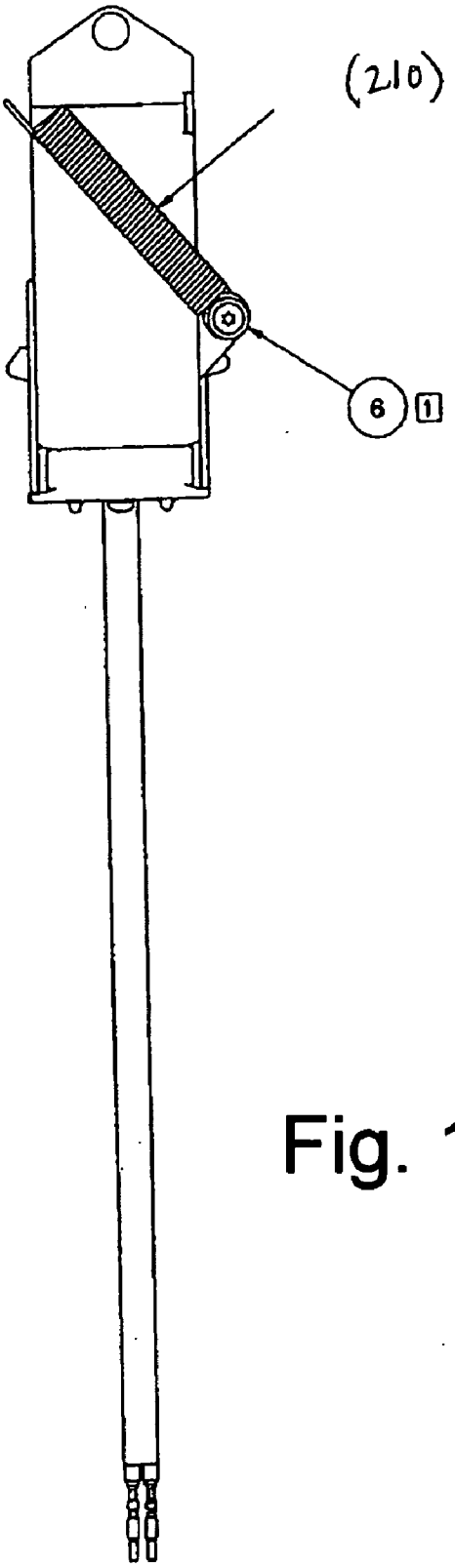



Fig. 19J

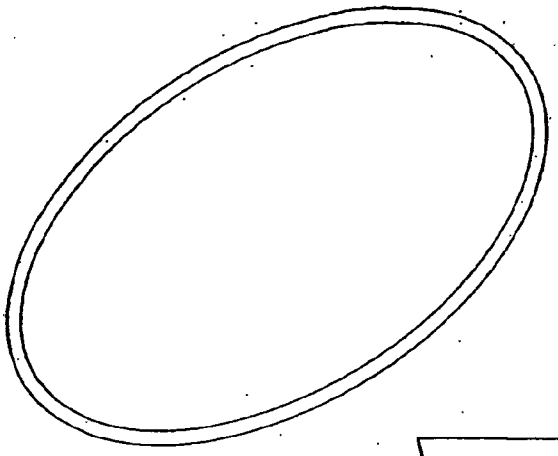


Fig. 20A

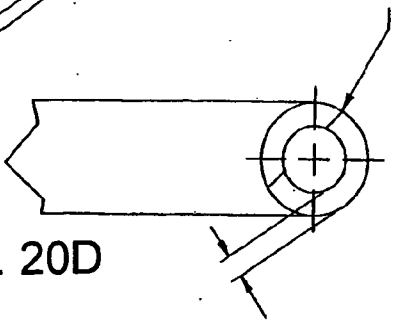


Fig. 20D

Fig. 20C

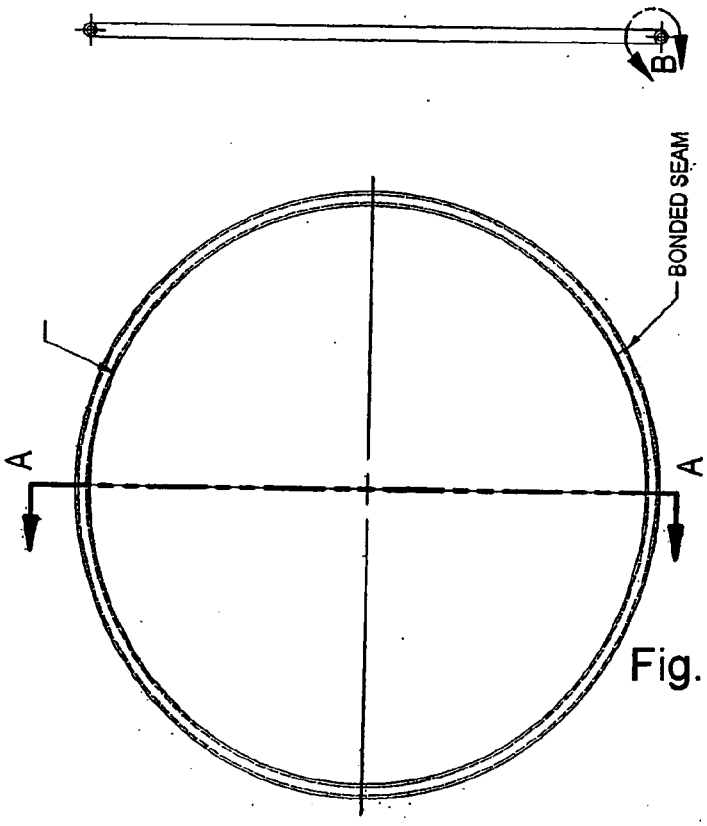



Fig. 20B

# SINGLE ARM MOGUL MOUNT FOR SPORTS LIGHTING FIXTURES

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. § 119 of a provisional application U.S. Ser. No. 60/644,719 filed Jan. 18, 2005, herein incorporated by reference in its entirety. This application is also a non-provisional of the following provisional U.S. applications, all filed Jan. 18, 2005: U.S. Ser. No. 60/644,639; U.S. Ser. No. 60/644,536; U.S. Ser. No. 60/644,747; U.S. Ser. No. 60/644,534; U.S. Ser. No. 60/644,720; U.S. Ser. No. 60/644,688; U.S. Ser. No. 60/644,636; U.S. Ser. No. 60/644,517; U.S. Ser. No. 60/644,609; U.S. Ser. No. 60/644,516; U.S. Ser. No. 60/644,546; U.S. Ser. No. 60/644,547; U.S. Ser. No. 60/644,638; U.S. Ser. No. 60/644,537; U.S. Ser. No. 60/644,637; U.S. Ser. No. 60/644,784; U.S. Ser. No. 60/644,687, each of which is herein incorporated by reference in its entirety.

## INCORPORATION BY REFERENCE

[0002] The contents of the following U.S. Patents are incorporated by reference by their entirety: U.S. Pat. Nos. 4,816,974; 4,947,303; 5,161,883; 5,600,537; 5,816,691; 5,856,721; 6,036,338.

## I. BACKGROUND OF THE INVENTION

[0003] A. Field of the Invention

[0004] The present invention relates to lighting fixtures that produce high intensity, controlled, and concentrated light beams for use at relatively distant targets. In particular, the invention relates to such lighting fixtures, their methods of use, and their use in systems where a plurality of such fixtures are used in combination, usually elevated on poles, to compositely illuminate a target area energy-efficiently, with reduced glare and spill light, and with the capability to lower capital and/or operating costs. One primary example is illumination of a sports field.

[0005] B. Problems in the Art

[0006] Illumination of sports fields is generally called sports lighting. **FIGS. 1A-1G** illustrate one such sports lighting configuration. Football field **5** of **FIG. 1A** is illuminated by a set of arrays **1** of light fixtures **2** elevated on poles **6** (see **FIG. 1A**). As is well known in the art, there are known methods to design the number, type, and position of poles **6** and fixtures **2** to provide a desired or required amount and uniformity of light for the field. There are usually pre-designed lighting quantity and uniformity specifications to follow.

[0007] The most conventional form of sports lighting fixture **2** is a several feet in diameter bowl-shaped aluminum reflector with a transparent glass lens **3** suspended from a cross arm **7** fixed to a pole **6** by an adjustable knuckle **4** (see **FIG. 1B**). Each light fixture **2** has some adjustability both around vertical and horizontal axes. Each fixture **2** can therefore be uniquely aimed relative to the target area or field **5** by adjustment of knuckle **4** relative cross arm **7**.

[0008] This general configuration of sports lighting fixtures **2** has remained relatively constant over many years because it is a relatively economical and durable design. It represents a reasonable compromise between the desire to economically control high intensity light to a distant target while at the same time minimizing wind load, which is a particularly significant issue when fixtures are elevated out-of-doors to sometimes well over 100 feet in the air. A much larger reflector could control light better. However, the wind load would be impractical. A significant amount of the cost of sports lighting systems involves how the lights are elevated. The more wind load, the more robust and thus more expensive, the poles must be. Also, conventional aluminum bowl-shaped reflectors are formed by a spinning process.

[0009] Therefore, competing interests and issues provide challenges to sports lighting designers. Some of the interests and issues can be at odds with one another. Designers have to balance a number of factors, for example, cost, durability, size, weight, wind load, longevity, and maintenance issues, to name a few. Attempts to advance the art have mainly focused on discrete aspects of sports lighting.

## II. SUMMARY OF THE INVENTION

[0010] The present invention relates to a lighting fixture and structure to suspend it adjustably from a cross-arm. A relatively thin, single arm comprises the connection between cross-arm and mounting mogul or bulb cone, which in turn supports the remainder of the fixture. The single-arm provides several benefits for the fixture.

[0011] A. Objects, Features, or Advantages, of the Invention

[0012] It is therefore a principal object, feature, or advantage of the present invention to present a high intensity lighting fixture, its method of use, and its incorporation into a lighting system, which improves over or solves certain problems and deficiencies in the art.

[0013] Other objects, features, or advantages of the present invention include such a fixture, method, or system which can accomplish one or more of the following:

[0014] a) is robust and durable for most sports lighting or other typical applications for high intensity light fixtures of this type, whether outside or indoors;

[0015] b) can provide for decreased wind load or EPA for the fixture;

[0016] c) can provide for increased protection of wiring to the fixture;

[0017] d) can provide for decreased moment between the fixture and the mount.

[0018] These and other objects, features, advantages and aspects of the present invention will become more apparent with reference to the accompanying specification and claims.

## III. BRIEF DESCRIPTION OF THE DRAWINGS

[0019] All references to Figures are to the drawings in attached Appendix A.

[0020] A. General Sports Lighting Systems

[0021] **FIG. 1A** and its sub-parts B-G illustrate generally a sports lighting system, and conventional components for a sports lighting system.

[0022] B. General Parts of Fixture **10**

[0023] **FIG. 2** is a diagrammatic, partial exploded view of a light fixture **10** according to an exemplary embodiment of the present invention.

[0024] **FIGS. 3A** and B and **FIGS. 4A** and B show different assembled versions of Fixture **10**.

[0025] C. Reflector Frame **30** (Diverging Bottom and/or Side Shift)

[0026] **FIG. 5A** and its sub-parts are plan views of one example of a reflector frame according to an exemplary embodiment of the present invention.

[0027] D. Lamp Cone **40**

[0028] **FIG. 6A** and its sub-parts are various plan, sectional, and isolated views of a lamp cone according to an aspect of the invention.

[0029] E. Knuckle Plate **60**

[0030] **FIG. 7A** and its sub-parts are a perspective view, various plan views, sections, and isolated views of a knuckle plate according to an aspect of the invention.

[0031] **FIG. 8A** and sub-parts illustrate a gasket used with Fixture **10**.

[0032] **FIG. 9A** and its sub-parts are various views of a bolt for holding a knuckle of **FIG. 14** to the lamp cone of **FIG. 6**.

[0033] **FIG. 10A** and its sub-parts are various views of an O-ring the seal the knuckle bolt of **FIG. 9AA**.

[0034] **FIG. 11A** and its sub-parts are various views of a washer useable with the knuckle bolt.

[0035] **FIG. 12A** and its sub-parts are various views of a washer useable with the knuckle O-ring of **FIG. 10A**.

[0036] **FIG. 13A** and its sub-parts are various views of a knuckle cone strap bolt useable with the knuckle of **FIG. 14A** and the lamp cone of **FIG. 6A**.

[0037] F. Knuckle **50**

[0038] **FIG. 11A** and its sub-parts are various views of a knuckle connectable between the knuckle plate of **FIG. 7A** and the lamp cone of **FIG. 6A**.

[0039] **FIG. 15A** and its sub-parts are front and side views of a zero alignment gauge useable with the knuckle of **FIG. 14A** and the lamp cone of **FIG. 6A**.

[0040] **FIG. 16A** and sub-parts illustrate an alignment gauge usable with Fixture **10**.

[0041] **FIGS. 17A, 18A**, and **19**A, and their subparts, are various views, respectively, of an inside strap, outside strap, and inside stop strap useable with lamp cone of **FIG. 6A** to provide for accurate repositioning of the lamp cone if moved from factory alignment, for example, for maintenance purposes.

[0042] G. Miscellaneous Parts

[0043] **FIG. 20A** and its sub-parts are various views of a reflector gasket to seal the reflector frame at its connection to the lamp cone.

## IV. DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0044] A. Overview

[0045] An embodiment of a light fixture will be described in the context of sports lighting, sports lighting fixtures, and sports lighting systems for the illumination of athletic fields such as shown in **FIGS. 1A and 1C**. The lighting must light the field and a volume of space above the field (collectively sometimes called the target area or target space), according to predetermined lighting level and uniformity specifications. The embodiment relates to fixtures that utilize high intensity discharge (HID) lamps, presently normally 1,000 watts or higher, of the metal halide type. Such installations generally have several arrays of fixtures usually elevated on two or more relatively tall poles (35 feet to 100 or more feet).

[0046] B. Exemplary Apparatus

[0047] 1. Lighting Fixture **10** Generally

[0048] **FIG. 2** shows the basic components of sports lighting fixture **10** in exploded form. **FIGS. 3A** and B show it in perspective form. **FIGS. 4A** and B show an alternative form. Fixture **10** has some similar general components to state-of-the-art sports lighting fixtures, but introduces some different structural components and concepts. Mounting or knuckle plate **60** (360 Aluminum with polyester powder coat) bolts to the underside of a cross arm **7**. It has adjustability around vertical axis **62** (see **FIG. 7A**). Knuckle **50** (360 Aluminum with polyester powder coat) bolts at one end to the bottom of knuckle plate **60** and extends to a pivot connection to lamp cone **40** along axis **52** at its other end (See **FIG. 4**). It should be appreciated that knuckle **50** essentially supports the remainder of fixture **10** and does so with essentially one arm extending from a cross arm down to one side of lamp cone **40**. Knuckle **50** is a relatively non-complex structure.

[0049] Lamp cone **40** (360 Aluminum with polyester powder coat) pivots around axis **52** relative to knuckle **50**. It contains a socket **154** (see **FIG. 19A**, commercially available) which is bolted to the flat web **160** between the arms **156** and **158** of yoke **80** (see **FIG. 19A**). Lamp **20** (Musco Corporation Z-Lamp™) has a threaded base that can be screwed in and out of socket **154** (shown screwed into operating position in **FIG. 2**) to install or remove lamp **20**.

[0050] 2. Lamp Cone **40**, Knuckle **50**, and Knuckle Plate **60**

[0051] Lamp cone **40**, knuckle **50**, and knuckle plate **60** form the adjustable joint between cross arm **7** and reflector frame **32**. Lamp cone **40** also supports lamp **20**. **FIG. 6A** and subparts illustrate details about lamp cone **40**. Lamp cone **40** is basically enclosed except for front opening **132** to which reflector frame **30** is bolted and sealed with a gasket, and several opening in the side (e.g., for the knuckle bolt and a pinion gear).

[0052] Lamp cone **40** pivotally attaches to knuckle **50** by inserting laterally projecting boss or pivot **136** on the side of lamp cone **40** into a complimentary circular cut-out or receiver **172** in one lateral side of knuckle **50** (see **FIG. 14C**). Knuckle bolt **174** (see FIGS. **9**A, **10-12**), with appropriate nut and washers, holds lamp cone **40** from separation from knuckle **50** when assembled together. Gasket **176**

(FIGS. **8**A-D) fits between lamp cone **40** and knuckle **50** concentrically about pivot receiver **172** and opening **174** and knuckle **50** to deter water, insects, or dirt from entering into knuckle **50**. As can be seen in **FIGS. 6 and 14**, when these parts are assembled, complimentary structure on the interfaces of lamp cone **40** and knuckle **50** act as bearing surfaces and retaining structure to provide for smooth, accurate rotation of lamp cone **40** relative to knuckle **50**.

[**0053**] As shown in the drawings, knuckle **50** connects to knuckle plate **60** (see **FIG. 7A**) which in turn is fixedly mounted to cross arm **7**. Arm portion **178** of knuckle **50** extends to a mounting end **180**. Knuckle plate **60** bolts to the bottom of cross arm **7** by one bolt into each curved slot **194** and **196**. This allows rotational adjustment of knuckle plate **60** relative to cross arm **7** over the range of curved slots **194** and **196**.

[**0054**] It should be noted that knuckle **50** is essentially a single arm suspending most of fixture **10** by its pivotal connection along the side of lamp cone **40**. Unlike some existing fixtures which have the knuckle extend directly into the back of the lamp cone, and a pivot joint between the cross arm and the lamp cone, knuckle **50** provides certain functional advantages. First, although fixture **10** might be somewhat heavier than a spun aluminum reflector fixture, by placing the pivot point along the side of lamp cone **40**, there is less moment caused by lamp cone **40**, reflector frame **30**, lamp **20**, visor **70** and the other components on the distal side of that connection point. It is believed the moment is cut approximately in half. This is beneficial for long-term durability, especially for fixtures experiencing a variety of outdoors forces and conditions, including high winds. Less moment for the connection also deters slippage or change in relationship between the lamp cone and cross arm, which could affect aiming. Secondly, it allows for a shorter fixture, in the sense the fixture is pulled closer to the vertical plane of the cross arm. This helps present a lower EPA. Third, knuckle **50** provides for minimum exposure of power wires to the environment. The wires pass through knuckle plate **60** (from the interior of cross arm **7**), through the interior of knuckle **50**, and into the interior of lamp cone **40**, completely enclosed by structure. Fourth, it is part of a relatively non-complex structure for the support and aiming of the fixture.

[**0055**] Round opening **182** at the mounting end of **180** of knuckle **50** fits around downwardly extending tube **192** on the bottom of knuckle plate **60**. Bolts through bolt holes **184** and **186** of mounting end **180** of knuckle **50** extend into curved slots **194** and **196** in knuckle plate **60**. This combination allows a range of rotational adjustment of knuckle **50** relative to knuckle plate **60** (over the range defined by curved slots **194** and **196** of knuckle plate **60**). In this manner, there is some adjustability of knuckle **50** around a vertical axis, once knuckle plate **60** is mounted to the underside of cross arm **7**.

[**0056**] Curved slot **188** in knuckle **50** provides a limit for pivoting of lamp cone **40** about knuckle **50**. Knuckle **50** can therefore be used for aiming fixtures **10** to either side of cross arm **7**. Additionally, lamp cone **40** can be set to a given aiming angle relative knuckle **50** as follows. An inside stop strap **142** can be fixed to boss **144** in the face of lamp cone **40**. Inner and outer stop straps **146** and **148** can be bolted on opposite sides of curved slot **188** of knuckle **50** in a position so that when lamp cone **40** is rotationally adjusted relative to knuckle **50** for its intended aiming angle, inner and outer straps **146** and **148** would come into abutment with stop strap **142**. Thus, the installer of the light system can have a factory-preset stop at the correct aiming angle for each fixture **10**. This avoids individual aiming of each fixture when the system is installed at the field. Additionally, it allows easier maintenance. Bolt **174** holding lamp cone **40** to knuckle **50** can be loosened, lamp cone **40** and reflector frame **30** etc. can be swung down. Maintenance can be performed. Without realigning or re-aiming, the worker then only has to swing that reflector frame **30** etc. back up until it hits stop strap **142** and retighten lamp cone **40** to knuckle **50**. Knuckle **50** can be die cast and removable mounted to die cast reflector frame **30** with gaskets or other structure to prevent leaks at that interface of parts.

[**0057**] C. Assembly and Use

[**0058**] In practice, a set of fixtures **10**, such as described above, would be used in a sports lighting system customized for a particular sports field. Lighting specifications (usually including light quantity and uniformity minimums; and sometimes glare, spill, and halo light limitations) are usually prepared or known. As is well known in the art, computer software can design the lighting system, including what types of beams and beam shapes from how many fixtures at what locations are needed to meet the specifications. It can generate a report indicating number of fixtures, pole locations, beam types, and aiming angles to meet the design.

[**0059**] As described above, fixtures **10** can be assembled to produce a wide variety of beams and commonly used beam shapes for sports lighting. Using the report, a set of fixtures **10** can be pre-assembled at the factory. The appropriate reflector frame **30** for each beam type called for in the report can be pulled from inventory by the assembly worker. About one-half the reflector frames will include a side shift section **109** (and about one-half of those split between left shift and right shift). Likewise, the appropriate reflector inserts **120**, visor **70**A or B, and visor reflective inserts **72** will be pulled from inventory for each fixture according to its position and function in the report.

[**0060**] The assembly worker(s) will mount the appropriate reflective inserts **120** on the pins on each reflector frame **30**, and the appropriate visor reflective strips **72** on visor **70** for each fixture **10** (depending on the precise structure of visor **70**, mounting straps or brackets may first be secured to visor **70**). Glass lens **54**, with anti-reflective coatings on both sides installed, is assembled into lens rim **230** with visor **70** attached.

[**0061**] A Z-lamp™**20** of the appropriate wattage is screwed into socket **154** for each fixture **10** and aligned, through the pin and slot method and/or by correction slots, so that the plane defined by the longitudinal axis of arc tube **12** and the longitudinal axis of lamp **20** is in appropriate alignment relative to reflector frame **30**.

[**0062**] Other parts, including those specifically described above, are assembled, to complete each fixture **10** for the given lighting system, including latching the lens **54**/visor **70** combination over reflector frame **30**, and sealing all holes except for placement of filter in its designated opening. The assembly worker(s) take appropriate measures to avoid any foreign substances from adhering or being inside reflector

frame **30** after lens **54**/visor **70** is sealingly mounted to it. This includes peeling away the release sheet protective covers on the high reflectivity inserts for reflector frame **30** and visor **70**.

[**0063**] Fixtures **10**, a pole top with pre-assembled cross arms **7**, and poles are shipped to the field to be lighted, along with aiming diagrams, showing how each pre-designed fixture should be aimed relative the field. The entire system, namely poles and bases for the poles, cross arms, fixtures, wiring, ballast boxes, etc. can substantially pre-assembled at the factory (see Musco U.S. Pat. No. 5,600,537, incorporated by reference herein). This pre-assembled system is available from Musco Corporation under the Light Structure™ brand name.

[**0064**] At ground level, knuckle plates **60** are attached to cross arms **7** and the appropriate fixture **10** is attached to its appropriate knuckle plate **60** by its knuckle **50** (after wiring for that fixture is connected to pre-wiring in cross arm **7**. The knuckle for each fixture **10** is adjusted to match the indicated aiming for that fixture **10** according to the aiming diagram (using the pole as a reference point, as described later). Once aimed, the inner and outer knuckle straps and knuckle stop strap, are bolted in place so that the correct aiming position for the fixture is set. Any pivoting of fixture **10** above or below the reference position for arc tube **12** will result in automatic tilt factor correction movement of yoke **80** for that lamp **20**.

[**0065**] The poles are erected vertically. Electrical power from a control cabinet is connected to each ballast box on each pole.

[**0066**] It can therefore be seen that the invention achieves at least all of its stated objectives, aspects, advantages and options. It departs from the state-of-the-art in the ways described. It will be appreciated, however, that the invention can take various forms and embodiments. Variations obvious to those skilled in the art will be included within the invention, which is defined solely by its claims.

What is claimed is:

**1**. A high intensity lighting fixture for increasing useable light to a target area without an increase in energy use comprising:

a. a lamp cone;

b. a knuckle attachable to the lamp cone for use in adjustable mounting to a cross-arm or other suspending structure;

c. a reflector mountable to the lamp cone and comprising a bowl-shaped outer surface and an inner surface including a reflecting surface, and a primary opening over which a glass lens is mountable;

d. a high intensity discharge lamp having a base mountable into the lamp cone and an arc tube positionable in the interior of the reflector frame substantially surrounded by the reflecting surfaces;

e. the knuckle pivotably attachable to the lamp cone along its side.

**2**. The fixture of claim 1 wherein the knuckle is relatively thin compared to the lamp cone.

**3**. The fixture of claim 1 further comprising a sealing member between the knuckle and the lamp cone.

**4**. The fixture of claim 1 further comprising substantially internal pathways for wiring into the lamp cone for protection of the wiring.

**5**. The fixture of claim 1 wherein the pivotal attachment of the knuckle to the lamp cone along its side provides decreased moment.

**6**. A high intensity lighting fixture comprising:

a. a lamp cone;

b. a knuckle for use in adjustable mounting to a cross arm or other suspending structures;

c. the knuckle pivotally attachable to the lamp cone along its side.

**7**. A method for decreasing moment and effective projected area where a lighting comprises:

a. mounting a knuckle for attaching the light fixture cross arm along the side of a lamp cone of the fixture.

* * * * *